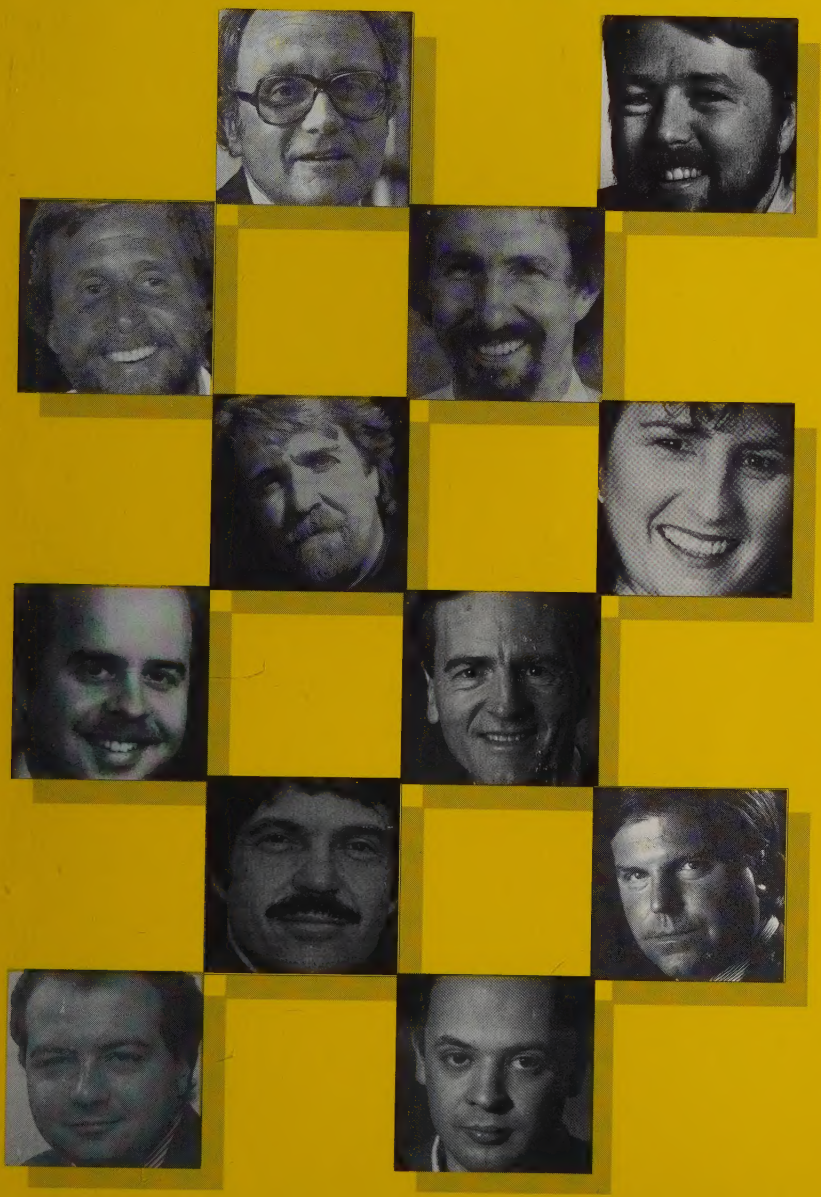
Technologies for the 21st Century

ON MULTIMEDIA



Martin Greenberger,
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Technologies for the 21st Century

ON MULTIMEDIA

Martin Greenberger
Editor

The Voyager Company
Santa Monica, California

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The Roundtable in Multimedia

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in cooperation with
Multimedia Computing Corporation
Council for Technology and the Individual

March 26-27, 1990

Discussions Aimed at Fostering an Environment Conducive to Creativity and Constructive Competition

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In Anticipation

When chemical elements combine, the compound that results can show properties strikingly different from those of its components. This has been the way with computer technology. The computer is like a roving chemical agent, inducing reactions and producing combinations that change past patterns and herald new forms. In the process, the image of the computer changes along with the environment it transforms. The net effect is to push civilization forward in ways that can be wonderful or worrisome, according to one's point of view.

> *In a brief span of years, the computer has grown remarkably in every way except physical size. It has become faster, more versatile, and more reliable; it has become a much better communicator with its external environment; it has developed a memory of impressive speed and capacity; and it has become articulate in many languages.*[1]

This was written in 1962, when the still youthful computer had not yet reached its eighteenth birthday. Today, on a human time scale, the technology is middle-aged. It has had an eventful two-score-and-five-plus years. Its credits for innovation extend from bookkeeping to biochemistry, from financial management to physical research, and include hosts of important applications in education, engineering, insurance, medicine, manufacturing, refinery operations, printing, publishing, aviation, satellite communications, space exploration, and an almost endless list of other areas. At about the right age for the computer came its marriage with communications, a union from which both parties have benefitted handsomely.

[1] Greenberger, *Computers and the World of the Future*, p. v.

In Anticipation

With all its varied combinations, applications, and embodiments, the computer today bears scant resemblance to the electromechanical Automatic Sequence Controlled Calculator, born at Harvard in 1944.[2] No one at that time could have foreseen how profoundly microelectronics and creative genius would revolutionize computer technology and so vastly expand its range of uses. No one was then thinking about the computer as the highly versatile and extraordinarily important medium of expression it has since become.[3]

From its prodigious performance and awesome growth, one might conclude that the computer, surely, has now reached adulthood. But it is still just an infant when measured on the time scale, not of human longevity, but of human sensory development. After all, the computer can barely talk or touch. Its recognition of human speech is halting, its visual perception faulty, and its sense of taste and smell quite dormant.

Intellectually precocious, mighty in feats, yet weak in senses — that has been the state of the computer. The scene now changes. The computer is found romancing with television, music, photography, and other artistic media — media that emphasize the auditory and visual dimensions on which the computer has been feeblest.

Just a decade after personal computers revolutionized the industry, they may be about to do it again — this time with multimedia. The concept no longer

[2]This first completely automatic computer, known as the Mark I, was electromechanical in operation. Built with components and techniques borrowed from IBM punched-card machines, the Mark I was conceived in 1937 by Harvard University professor Howard H. Aiken. It was constructed in collaboration with IBM, who then presented the completed machine to the University on August 7, 1944. The first electronic computer was the ENIAC (Electronic Numerical Integrator and Computer) designed by J. Presper Eckert and John W. Mauchly of the Moore School of Engineering at the University of Pennsylvania. The ENIAC was completed in the summer of 1946.

[3]Alan Kay, in commenting on Marshall McLuhan, writes, "Though much of what McLuhan wrote was obscure and arguable, the sum total to me was a shock that reverberates even now. The computer is a medium! I had always thought of it as a tool, perhaps a vehicle — a much weaker conception. What McLuhan was saying is that if the personal computer is a truly new medium then the very use of it would actually change the thought patterns of an entire civilization." [Alan Kay in Brenda Laurel, p. 193. (See Bibliography for full reference.)]

refers simply to the slide and audio shows of the past, but much more importantly to the vast new possibilities opened by recent advances in digital technologies. As personal computers expand into the video and audio domains, a dazzling new hybrid emerges — a computer that can produce sharp, moving color images on the same screen with text and graphics, a device that combines high fidelity sound with imaginative software. The computer is becoming a multimedia tool that has the potential to change the way we do many things that matter a great deal to us, among them communicate, explore, work, learn, and play.

By putting high quality sound and video under the control of people at computers, the convergence brings together the perceptive with the cognitive, the sensory with the logical. It is as though the left side of the brain were being combined with the right.

The meaning of multimedia and how it appears depends very much on the perspective of the observer. People in the computer field will see the development differently from artists or people in the television industry. The substance of the different meanings and perspectives is crucial.

Computer companies are seriously courting the entertainment industries. But their enthusiasm is not necessarily returned by a desire of the television companies to get cozy with computing. Television and artistic interests are understandably wary of bit-playing character-manipulators preaching interactivity and worshiping a logical rather than an aesthetic deity. The changes coming from a liaison with computers could threaten people dedicated to traditional forms of artistic expression.

We hardly need reminding that technical design is not the only way the computer and television set are dissimilar. One technology appeals to the intellect, the other to the heart. Both energize and transport, but in different ways and in different directions. The first feels active and alive, the other

passive and reflective. One is associated with analytical modeling and problem-solving, the other with reverie, relaxation, and escape. One deals in abstract symbols, the other in real images. These important distinctions are echoed in the mores and values of the people working with the respective technologies.

These camps no longer consist simply of two families of engineers with different backgrounds, as was the case with computers and communications. There are now two entirely different cultures — analytical and artistic — looking askance at, and sometimes feeling uncomfortable with, each other. We are reminded of the two cultures of Charles Percy Snow:

> *Literary intellectuals at one pole — at the other scientists . . . . Between the two a gulf of mutual incomprehension — sometimes . . . hostility and dislike, but most of all lack of understanding. They have a curious distorted image of each other. Their attitudes are so different that, even on the level of emotion, they can't find much common ground.*[4]

Lord Snow lived his own life centered in both of the worlds he described. He was an author, and enough respected as a scientist to be put in charge of Britain's scientific research recruitment during World War II. When he looked down from his position straddling the literary and scientific camps, what he saw was a deep and widening divide.

But we find the divide between the computer and television cultures may be narrowing, not widening. Talented people who seem at home on both sides are emerging. They are creative, productive, and influential. Their numbers are growing.

[4]Snow, pp. 4-5.

The computer and television cultures are finding things to talk about, argue over, and agree upon. On the engineering level, standards are an unavoidable subject of debate, and the comparative merits of digital versus analog is a favorite topic of discussion. Members of both cultures are doing interesting and enjoyable things with user-accessible software like HyperCard and Toolbook. Both use phrases such as *multimedia, hypermedia, intermedia, interactive media, new media, interactive video,* and *desktop video* to describe how their work uses the other's medium. Both think about potential markets and product definitions, and both are concerned with the problem of raising funds.

In other words, a common ground of interests and concerns is developing. The boundary between the two cultures is not impenetrable. In fact, there may be more commonality than anyone realized.

Furthermore, few on either side would really want to keep television as it is. Within the television industry itself, there's been much criticism of the use of the medium. Over 30 years ago Edward R. Murrow argued:

> *Unless we get up off our fat surpluses and recognize that television in the main is being used to distract, to delude, amuse, and insulate us, then television and those who finance it, those who look at it, and those who work at it may see a totally different picture too late. . . . This instrument can teach. It can illuminate. Yes, it can even inspire. But it can do so only to the extent that humans are determined to use it to those ends. Otherwise it is merely lights and wires in a box.*[5]

Murrow's statement is quoted today by people within the TV industry who would like to see computers used actively to make television the instrument for illumination and learning it was once expected to be. These multimedia proponents are hoping for a new start.

[5] Chicago, October 15, 1958.

In Anticipation

In the summer of 1989, I met with Jack Sculley, Nick Arnett, and Tim Bajarin in Boston to discuss ways we might bring together leaders in multimedia from the different industries to discuss issues of common concern. Bob Abel had told me about Jack Sculley's interest in identifying a network or community of persons concerned with multimedia. Jack was associated with Nick Arnett and Tim Bajarin at the Multimedia Computing Corporation, and had been involved in multimedia productions for Apple Computer. He was in the process of forming his own multimedia production firm.

Creating an "invisible college" for the field, as it were, seemed like a good idea. My own interest in multimedia had been stimulated by a year of engrossing work at the MIT Media Laboratory, where I had been on sabbatical leave from UCLA.

We decided to organize a UCLA Roundtable in Multimedia. Jack Sculley and I took on the project jointly. We did not want the event to be another wrangling over standards, or just an occasion for product demonstrations. We wanted a conference that would bring together highly talented people from various fields, who might not otherwise have a chance to meet. We hoped the conference might serve as a catalyst for joint efforts.

Many ideas for discussion topics crossed my mind. Left to my own devices, I might have chosen, for example, to direct attention to the role and future of television, a subject often neglected by academicians:

> *We need to know why so many fear the visual media; we need also to know why scholars so rarely make serious efforts to understand the substantial conquests achieved by [it]. . . . While temporarily creating certain homogeneities, will [it] in the long run have the effect of producing greater difference?*[6]

[6] Daedalus, "Print Culture and Video Culture," page vi (See Bibliography).

Or, the group might have focused on the regulatory morass that could develop as broadcasting, publishing, computers, and communications continue to come closer together:

> *[This] country has a trifurcated communication system. In three domains of communication — print, common carriage, and broadcasting — the law has evolved separately, and in each domain with but modest relation to the others. In the domain of print. . . the First Amendment truly governs. . . . In the domain of common carriers, which includes the telephone, the telegraph, the postal system, and now some computer networks, . . . a common carrier. . . is obligated to serve all on equal terms without discrimination. Finally, in the domain of broadcasting, . . . broadcasters are selected by the government for merit in its eyes, assigned a slice each of the spectrum of frequencies, and required to use that assignment fairly and for community welfare as defined by state authorities. . . [A] politically managed system has been invented.*[7]

Or, in an historical vein, we might have recalled Gutenberg, finding parallels between the Renaissance and computers today:

> *The computer [could], in the long run, change the whole nature of the medium. Thus it was also in the early days of printing, when the Gutenbergian principle was introduced to reduce the labor of copying text but stayed to change the nature of text itself and its role in society. . . . The new printing presses of the fifteenth and sixteenth centuries were brought in to ease the pressure of demand on the European system of manuscript copying, but they then changed the way in which ideas circulated and facilitated new national cultures based upon the printed word.*[8]

[7] Pool, *Technologies of Freedom*, p. 2 (See Bibliography).

[8] Smith, *Goodbye Gutenberg: The Newspaper Revolution of the 1980s*, pp. xii and 323 (See Bibliography).

This might have led to the consideration of who will control the information and whether control might someday be exercised, in effect, by users themselves, a concept called *broadcatch* or *user sovereignty*, depending on the context:

> *[The] invention of printing moved to the writer and away from the keeper of the text the power to guarantee the text. This in turn shifted to government the task of controlling and channeling the power of the text within society. . . . In computer-controlled information systems the sovereignty over the text moves from the supplier of information to the controller of the technology. Already in the broadcast media we have seen the development of controlling institutions based upon the transmission technology (and justified by a supposed shortage of spectrum capacity) rather than upon the content.*[9]

But something told us that such weighty issues were more the substance of scholarly discussions and provocative books than the concerns of people on the front lines. To find out before the Roundtable, we sent out a set of issues for participants to vote on. We classified the issues into the areas of: (1) education, (2) the home market, (3) business applications, (4) copyright, (5) networks, (6) public policy, and (7) the future of the mass media. The results of the poll clearly favored the first four areas over the last three. We made these areas the subjects of sessions at the Roundtable.

We also invited participants to make additions to the list. Max Whitby, senior producer for the BBC Interactive Television Unit in London, proposed the following:

> *The question I would like to raise is whether we have yet invented a satisfactory grammar for the new medium that is sufficiently effective to work for*

[9] *Ibid.*, pp. 20-21.

> *large numbers of people. A defining characteristic of interactive multimedia is that it allows the consumer to intervene in the presentation of information and to divert the flow or adjust the level of detail according to his or her interest and experience. This very process of intervention seems inevitably to break the spell of engagement with linear media that is such a powerful characteristic of effective storytelling. Is interaction compatible with narrative? Which of the various forms that are beginning to emerge — menus, guides, spatial environments, encouragement of user composition — offer the best hope of persuading people to consume multimedia in preference to cinema and above all TV?*

We liked Whitby's suggestion a great deal, but could not be sure if the rest of the group would share this interest. So we included a session in the Roundtable whose agenda was *To Be Determined (TBD)*, and made Max its moderator. We also included people in the session who might steer the discussion into public policy or the future of the mass media, if that turned out to be the interest.[10]

We bracketed these five sessions with three others: an opening session called *Pushing the Envelope*, comprised of personal talks by three artists widely acclaimed for their work (Robert Winter, George Coates, and Robert Abel), a follow-up session called *Making It Happen*, consisting of personal talks by executives from two major computer companies aggressively pursuing multimedia (Lucie Fjeldstad from IBM and John Sculley from Apple Computer), and a concluding session moderated by Nicholas Negroponte of the MIT Media Lab with Jonathan Seybold and Nick Arnett as rapporteurs.

The meeting began on the afternoon of March 26, 1990 with informal multimedia demonstrations by Robert Abel (*Guernica* and *Ulysses*), Hans Peter Brondmo of the MIT Media Lab (HyperMedia and *Micons*), Ching-chih Chen

[10] As it turned out, much of the time was spent on standards.

of Simmons College *(Project Emperor I)*, Reese Jones of Farallon Computing (*MacRecorder* and *MediaTracks*), and Bernard Luskin of American Interactive Media (CD-I). These demonstrations were intended as background for the subsequent talks and interchange. There were no demonstrations during the discussions themselves.

The initial two sessions of the Roundtable took place after dinner on the first evening. This provided a warm-up for the next six sessions on the following day, each with a moderator and three to four panelists. The panelists were asked to restrict their opening remarks to seven minutes to allow time for general discussion.

Such was the format. There were seventy participants in all. Those who spoke were free to talk about whatever they wanted — and they did. For the most part, we did not know in advance what would be said. That was to encourage spontaneity and avoid unnecessary constraint.

Eight chapters of this book are based on the recorded transcript of the Roundtable sessions. Since there were no prepared papers, and much of the discussion was extemporaneous, I took extensive license as editor in rendering what was said into readable prose. We sent the edited versions of remarks to all who spoke, to allow them to make corrections and ensure that the integrity of their intent was intact, but cannot be sure that they were all able to check copy within the two-week period provided. With apologies to those affected, I take full responsibility for the distortions of meaning and rough edges that remain.

The objectives of the Roundtable, as I set them forth in my opening remarks, were three in number:

The first reason was simply to get together. In that multimedia is the merging of many activities not previously recognized as having common interests

— forging a new instrumentality for learning, informing, entertaining, and artistic expression — it opens up a vast array of uncharted opportunities in the intellectual, commercial, and social spheres. The ambitious goals being set for multimedia today cannot possibly be achieved by any one individual or company alone. Collaborating across the board is necessary. The first step was to get to know each other. There would be some of the "usual suspects" at the Roundtable, but many faces would be new. Many participants might not otherwise have had the chance to meet.

Second, the opportunities for progress in multimedia are matched by the likelihood for missteps — missteps that could become obstacles to further advances in the field. There are many examples in earlier attempts to apply technology in areas such as communications, education, and the home. By joining forces to discuss the major issues, and by learning from each other, we would have a better chance of avoiding errors and of learning from past mistakes.

The third objective derives from the first two. The Roundtable might provide an appropriate and helpful framework for launching action programs that could help everyone. We asked participants to come up with ideas. This was an important part of the business of the second day.

The major consequence of such a meeting, of course, comes in the months afterwards. Recognizing this, I included a final chapter in the book — *In Retrospect* — reporting on reflections and events that occurred after the meeting. It presents an overview of the meeting, gives impressions of the extent to which the meeting's objectives were achieved, and reviews the many suggestions that participants made for action programs.

The book has a glossary designed to ease the challenge of dealing with the variety of fields represented. Each field has its own vernacular. The format of the meeting encouraged people to speak off the cuff, without time to

define their terms. Numerous acronyms, jargon, and abbreviations lace the discussions. For these reasons, we went to considerable effort to prepare the glossary. We hope the reader will take advantage of it.

Now for some acknowledgements. This part of the introduction is the most pleasant to write. In the final stages of editing the book, Gloria Garvin has been a gift from the heavens. Bill Brown has given us the benefit of his keen eye for design, and Aleen Stein, Nan Mott, Tami Tsark, David Krieger, and Elizabeth Collumb have been diligent readers.

As for the Roundtable, many people helped plan and execute it. Jack Sculley and Nick Arnett were there from start to finish. They provided excellent advice and essential moral support, as did Ching-chih Chen, Jonathan Seybold, and my UCLA colleagues Mitsuru Kataoka, Richard Lanham, and Robert Winter.

Companies providing funds for the Roundtable make up a baker's dozen. They are listed separately. We thank them sincerely, with the hope that the project has met their expectations.

Last, but far from least, are the three people who provided the day-to-day assistance that made it all possible: stalwarts Nancy Carson, Zina Tatsugawa, and my wife, Liz Greenberger. Liz deserves appreciation for other reasons as well. I'll be sure to tell her.

Martin Greenberger
Los Angeles, California
October 1990

Jack Sculley, Moderator
Robert Winter
George Coates
Robert Abel

Successful applications of computer technology have always depended on people value-adders such as systems programmers, language developers, application designers, database creators, and an army of customizers, not to mention the users themselves. With art, music, and moviemaking coming to the computer screen, the creative artist or author enters the picture. "Content providers" are of principal importance to the acceptance of a multimedia product. Their work and ideas have begun to shape the development of the field — a trend more than likely to continue. In this opening session, three highly regarded artist/innovators set the stage for the ensuing discussion by recounting their personal experiences in producing multimedia, indicating where they want to go with their work, the obstacles they foresee, and the resources they require. Robert Winter stresses the need for a change in attitude and examines the disorder in multimedia at the present time. George Coates tells of his work of many years taking multimedia outside the TV set onto three-dimensional "screens" with live performers. Robert Abel makes a plea for cooperative effort to "change the world," and sets a date for returning to the same venue to check on progress. Jack Sculley, as moderator, begins with an analogy.

■ Jack Sculley

In thinking about the role this conference might play in the development of interactive media, I am reminded of the *back to the future* thinking a certain futurist would use in his predictions. He would envision the world fifty years hence, then reflect on the major events that would have had to occur in the intervening years to bring about his hypothetical world.

A similar exercise done for interactive media might contemplate a process of integration and coalescence tracing its roots to this conference. My interest in science and history suggests some parallels with another emerging field over sixty years ago.

In 1927, the scientific world was in the midst of an upheaval which would shake every branch to its core and result in the creation of the physics of nature on its smallest scale. Rapid progress in science since the Industrial Revolution had brought about wildly variant pictures of how the universe operated. In the mechanical world view, an endless array of microscopic springs and levers held matter together. In the theory of electrodynamics, on the other hand, electric and magnetic forces were being propagated through an omnipresent, imperceptible ether.

Both models were wrong. Research in the early part of the century pitted scientist against scientist, confusing the public, government, and industry.

> *In our scientific expectation we have grown antipodes. You [Max Born] believe in God playing dice and I [Albert Einstein] in perfect laws in the world of things existing as real objects, which I try to grasp in a wildly speculative way.*[11]

In the latter part of 1927, a conference was held at Lake Como, Italy, to bring together for the first time almost every significant contributor to the science of the time. The impact of the work of Einstein, Schrodinger, Curie and

[11] Taken from a letter from Albert Einstein to Max Born, dated November 7, 1944.

others was discussed in an environment of collaboration and open-mindedness. Out of the confused and turbulent climate came an atmosphere of cooperation and constructive competition. The great thinkers of the age were able to compare notes, debate the issues, and plan strategies to take advantage of recent discoveries.

The meeting was to prove a seminal event. A more cohesive picture of the world and of what was to become an entirely new science began to take shape. A common ground for the productive exchange of ideas developed, and the new gospel of quantum mechanics was preached in more and more quarters. By no means was there universal agreement, or even civility, but vigorous competition and a tremendous burst of productivity based on this common understanding ensured that the new science would prosper.

We would be very fortunate to have anything approaching the spectacular results of that meeting, but our objectives at the Roundtable are very similar. By bringing together leaders in the fields of interactive media, many for the first time, we hope to work toward developing a common ground and a basis for constructive competition and productivity.

At the Roundtable, we have pioneers blazing future trails that may lead us to an entirely new field and industry. In this first session on *Pushing the Envelope*, we will be hearing from three of these pioneers, all artists/innovators acclaimed for their work.

■ Winter

Jack Sculley stressed to me that he wanted this to be a kind of fireside chat, with autobiographical reminiscences rather than cosmic philosophy. Coming from a Yankee Puritan culture where we were taught never to use the word "I" in dinner conversation, that's difficult for me. But let me try, even though, being a teacher, I'm sure I'll backslide into philosophizing.

(Winter)

I teach in a department where opera, that multidimensional art, has been taught for decades from long-playing records. Ten years ago I asked a colleague if he would be interested in showing his students a film of an opera to which I had access. He was shocked by the suggestion.

Some people in my field still have not figured out reel-to-reel tape recorders, much less cassette players and computers. There are more than a few personal computers in unpacked boxes in my department. I brought a Kaypro to a departmental retreat in 1982, and demonstrated the cutting and pasting of words and phrases. It made my colleagues dizzy.

The conservative, academic environment in which I've worked all my professional life persuades me that the issues raised by multimedia are more political in nature than technological. Working with the Voyager Company, I recently authored a HyperCard program to accompany a compact-disc recording of *Beethoven's Ninth Symphony*.[12] I've shown it to about 10,000 people so far. Let me tap into the experiences I've had in doing this to illustrate what I mean by *political*.

The Eastman School of Music — about the best all-around school of music in America — has a very forward–looking director. He had come to my house, seen the *Beethoven*, ordered three copies, and arranged for me to show it at his school. I demonstrated it at the end of a very interesting roundtable he organized on teaching music to lower-division, undergraduate non-majors — to the *masses*, as it were.

After the demonstration, a thoughtful, well-respected professor from Princeton University, who's been teaching music appreciation successfully for the last forty years, stood up and said, "This is so seductive and appealing that

[12] Robert Winter, *Ludwig van Beethoven, Symphony No. 9*, The Voyager Company. Winter: "It was on New Year's Day,1989 that Voyager's Bob Stein brought over a CD-ROM drive, plugged it into my Apple computer saying, 'I think you might be interested in this,' and proceeded to show me what we could do with the system. That got us started on the road to *Beethoven's Ninth*."

the content could be terrible and no one would know the difference." How do we respond do this kind of reaction? It will, I believe, take a political reorientation to effect any changes.

Music may be the most culture-bound and abstract of the arts. In doing public radio for 15 years, and teaching in the university classroom even longer, I've had the following experience again and again. When I'm done with my lecture or presentation and about to depart, I have the feeling that I'm leaving behind a vacuum. The kids are going to go back to their dormitories to tell their roommates, "That was a fabulous point he made about . . . uhh . . . what was it again?" They no longer have any idea — or any way to reattach the idea to the music.

What struck me right away about multimedia was that I would be able to relate specific sounds to ideas for the first time even when I wasn't there with the user! You cannot overestimate what this powerful entry–level aspect of multimedia can mean to someone studying music.

Voyager took *Beethoven* to the annual meeting of the American Musicological Society. We had one of the tables in the back, along with traditional booksellers, a few record vendors, and some makers of old instruments — our program created near–pandemonium. People came by in droves. I turned the demonstrations over to my producer in order to watch the faces.

One woman stood like a rock for more than an hour. She did not budge. Her eyes were frozen. She was expressionless. Finally, she turned. I almost jumped on her, I was so eager to hear what she was thinking. She said, "This bothers me terribly." I said, "Well, gosh, I'm sure the company that published the product would like very much to know what bothers you. I'll pass on to them what you think needs to be done." She looked at me and said, "You know, there's something terribly wrong about all of this." I said, "Well, gee, I mean, what is it?" "It's too easy," she said. "When I was a

(Winter)
music major, in order to learn these kinds of things about the Ninth Symphony, I had to take the score out of the library, wrestle with the alto clef, remember that the middle C is in the middle of the five lines, and wend my way along. I had to know about transposing clarinets, and all the ins and outs of orchestration. I had to find everything on the keyboard myself. Now it's so simple that a ten-year-old can do it. That's just not fair!"

I smiled, realizing as I have so many times since, that we are really dealing with a political barrier — getting people to begin accepting the notion that the conventional barriers and constraints to learning are both extraneous and needlessly limiting.

For years, I've used terms like *enter-cation* and *edu-tainment* to refer to what I do. I think the division between education and entertainment is one we would all like to see bridged. And yet, at demonstrations to sophisticated users of Apple computers, I am inevitably asked, as a puzzled look comes over the struggling questioner's face, "Who is this for? I mean, is it for K-12, music majors, Egghead Software, or Tower Records?"

This kind of question tells me that people can only think of the product as an *either/or*, rather than a *both/and*. What multimedia is really about is *all of the above*. I think that's what my good colleague Martin Greenberger has in mind, and it's what Jack Sculley implied in referring to the 1927 conference at Lake Como.

On public radio, I did the only multimedia possible in the 1970s and 1980s — linear programs before a live audience that interspersed music performance and commentary. I got hundreds of letters from people saying they had recorded the programs to be able to play them back later. They were capturing the linear experience over the airwaves in hopes of being able to return to their favorite spots. What they really needed was multimedia.

What is our action program? How are we going to change people's orientations? I am working with Richard Lanham, my colleague from the English department, in preparing a set of proposals for the Office of Instructional Development at UCLA. Our hope is to bring multimedia onto the campus in a way that will begin to transform lower division courses in the fine arts and literature. The problem is, what we're proposing is fundamentally at odds with the kinds of pigeonholed curriculum we have imposed on higher education.

When I demonstrated *Beethoven* to the music department one afternoon, about 150 people came by, of whom 145 were students. (Our department has about 70 faculty members and 250 students.) Since it's the faculty who will have to persuade the deans, I toted in my own equipment to show some of my colleagues one at a time. I've invited colleagues to have lunch, and then said, "Why don't you come back to my office? I want to show you something."

The response has been remarkably uniform. To wit: "This is marvelous! It changes everything. But I've been teaching my course for 30 years this certain way and it works. I can't imagine putting in the effort required to use this technology. But it's wonderful! You're to be congratulated! Good luck!"

When FM radio first arrived, we knee-jerk liberals assumed it would be our salvation from the dreck of AM radio. Yet today, with the exception of a few programs like *All Things Considered* and *Morning Edition*, it's very difficult to tell the difference between the dreck on FM and the dreck on AM. Much the same, alas, seems to be true of cable television.

How then can multimedia contribute to transforming how we learn? It may call for guerrilla warfare. We're afraid to take on frontally the folks who map curricula. Should we design our programs to meet their guidelines or should

(Winter)
we tell them, "Look! Here's a very different way of approaching old problems. Let's at least consider changing the curriculum to make it fit." I suspect the answer is that we must do some of both.[13]

I'm counting on this Roundtable to give me some ideas for moving from guerrilla warfare to paratrooper assaults. Most of my professional career, I've either been writing, sitting on the concert stage with a piano, lecturing in front of a classroom, or talking and performing for a mass audience. To be suddenly toted — as I have for the last nine months — from *demoland* to *demoland* — has often been a baffling and bewildering experience.

One thing I've noticed at these shows is that finished products seem to be a rarity, as if by design. Is it because the technology is breaking so fast that what was done last month is already obsolete this month? Are we prisoners of the technology? (My good friend, Bob Abel, is nodding his head. He knows better than anyone what I'm talking about.) But I live in a content-based world where the only things that count are *completed* books and articles, not prospectuses. There has to be a way of bridging the gap.

A number of people who have seen *Beethoven* have said, "This is wonderful, but why didn't you do MIDI here, and why don't you have video there" — as if these possibilities hadn't occurred to us. But our priority was to address intensively the issue of interface between sound, text, graphics, and users — that seemed very ambitious to us. It was a maddening process. A week before the release date, I finally realized what had been vexing me throughout. The fact is that only a few sentences and one thought fit comfortably on a HyperCard screen. A good HyperCard product avoids sentence breaks

[13] Winter: "I happen to be in the middle of a three-year term on the Committee on Academic Personnel, the faculty group at UCLA that makes about 600 tenure and promotion decisions for the university each year. I sit with 13 people for 10 to 15 hours a week, absolutely raging about the value of a particular line of scientific inquiry or artistic endeavor. Then I go back into the trenches of the classrooms where things are actually done, and see what hills we have to climb to bring about change. I am convinced that unless content people of high calibre are motivated to get involved, there will be a great deal of wheel spinning in multimedia and progress will be slow."

between cards. Nobody wants to have to stop and scroll or flip pages electronically in the middle of a thought. But I was also trying to create a complex network of cross references that would offer users some of the benefits of hypertext. The problem, I realized, was that I had been trying to write *War and Peace* and *Doonesbury* at the same time. It was impossible.

A final issue — also political — bearing on the relationship of content to multimedia — has been neglected and is poorly understood at the present time. Multimedia is a synthesis: a hybrid offering the advantages of the user-driven book with the wonders of electronic technology. This produces a new set of relationships between content-providers (authors), publishers, hardware manufacturers, software companies, and marketing people. These new relationships raise a whole new set of issues.

We know how the book trade works. Acquisition editors go out, find the content people, and fold them into the time-tested and well–worn publishing system. There are development editors, copy editors, a marketing department, and a production/manufacturing arm, the last of which, while important to the final product, is not critical to the interface between the product and end-user. All of this is under one roof.

Multimedia, by contrast, is currently far–flung and chaotic. It's terribly confusing and bewildering for all parties concerned. Nobody quite knows what his role is. Publishers have to worry not only about production/manufacturing, but also about the hardware that serves their products. What are multimedia publishers? Are they firms that own content which they can license to themselves — content providers, in other words? Or are they, as before, companies looking for people with ideas? How will multimedia publishers sell their products in the future? Primarily to computer manufacturers? Through traditional channels? Or through channels that don't yet exist?

(Winter)

We might have expected software companies to have been the content providers. But the great majority of software companies have very little experience with content understood as knowledge. They are concerned with making a faster, meaner spreadsheet or a more flexible word-processing program. The first fledgling companies focusing on multimedia content are being born before our eyes. Few can start up solely as multimedia providers, since the market is so undeveloped. Most come to multimedia from related ventures, such as the Voyager Company with its Criterion Collection — a set of definitive films on videodiscs along with interactive, supplementary materials.

As for hardware manufacturers, they now find themselves interacting with content providers in ways that no bindery or book manufacturing plant ever imagined. Will they eventually become as peripheral to the multimedia market as binderies are to the book market? I don't think so.

Today, IBM and Apple are, by necessity, involved in every angle: content development, marketing, production, and not the least, persuading developers to create software for their hardware. They are called upon to behave like acquisition editors, making tough distinctions about quality and content that they have not been trained to make. Most have little experience in dealing with content providers, and may not even be sure what one is. Is it an entity with proprietary rights to newsreels, films, sound recordings, and visual art? Or someone who organizes knowledge and presents it in an innovative and engaging way, regardless of how the rights for the material are negotiated?

Authors, content providers, publishers, software companies, and hardware manufacturers, among others, are the elements in this teeming multimedia mix. Can they work together to each other's mutual benefit to begin this process of transformation? That's the overriding question. I hope the answer is yes. The '90s will be most interesting for all of us here.

■ Coates

I have been a *multimediator* for many years (though I know the field is still being invented). What my associates and I have been doing is working outside the TV set. I would propose that unless we get multimedia out of the box, all it's going to be is television. It may be interactive television, or better television, but though better than the network feed, it will still be tube-feeding. Multimedia provides too much information for it to work on that little screen. We need to start thinking about how to deliver it on a bigger and broader scale, so that people can experience it in the way they experience a concert, film, or large sporting event.

My work traces back to the events in the 1960s called *happenings*. People from different mediums would come together — dancers, artists, and sculptors — and improvise. These *happenings* later became so popular they got institutionalized as *intermedia*. Now they're becoming commercialized as *multimedia*.

Over the past 13 years, I've been working collaboratively with composers, programmers, robotics engineers, photo montage artists, and a wide variety of performers, opera singers, and dancers. Multimedia artists have developed interactive processes to enable live performers to appear within projected and animated environments. A flow of images is projected from the audience like a movie film, but onto a three-dimensional screen structure that can support the weight of live performers, rather than onto a two-dimensional movie screen that can display recorded performances only.

Imagine a movie screen that is sucked back, or alternately, extends out to the audience. The environments, locales, and effects are all projected onto the screen in actual 3-D, while the performers enter, exit, and dissolve right before the spectators' very eyes. It creates a stunning, magical effect. Audience interest is growing.

(Coates)

What makes it all possible is the radical tilt-stage — a tall floor-to-ceiling ramped or stepped film screen structure on which performers work — and a carefully designed lighting plot that illuminates the performers without washing out the projected media.[14] The audience is a broad-based, experience-oriented mix of people ranging in age from 20 to 60 years old. Kids love the stuff. Older people seem pleased with it and say, "Yes, it's really fascinating."[15]

Traditional theaters are beginning to adopt projected sets and radical tilt-stage design. My most recent production, *Right Mind*, produced at the American Conservatory Theater in downtown San Francisco, broke a 24-year record for advance sales before the October 17th quake brought the proscenium arch crashing down to the first fifteen rows in the orchestra. Fortunately, nobody was there at 5:30 in the afternoon.

I will not discuss the content of our productions in detail, except to admit that as multimediator of it all, I tend toward an interest in illusion, dreams, the workings of power, and the transformation of personality. *Right Mind* was a performance based on the life of Charles Lutwidge Dodgson; many of you know him as Lewis Carroll.[16] We investigated him as a multiple personality — an inventor, photographer, churchman, mathematician, and storyteller. He afforded us many opportunities to use multiple media to express the surrealist qualities of Alice's world, and to explore what he was doing as

[14] Coates: "These precious secrets keep me from having to do trade shows."

[15] Coates: "Certain people may be simply awed by things they've never seen before. Sometimes I feel the content could be awful and they would still like it. The problem should take care of itself in time."

[16] Dodgson (1832 - 1898) invented his pen name by translating his first two names into the Latin *Carolus Lodovicus* and then anglicizing the result into *Lewis Carroll*. He began at an early age to entertain himself and his family with magic tricks, marionette shows, and poems written from homemade newspapers. At Oxford, he lectured on mathematics and wrote treatises and guides for students. He took deacon's orders but was never ordained a priest due to a stammering problem. Among his other avocations was photography, at which he became proficient. As a mathematician, he was conservative and derivative; as a logician, he was more interested in logic as a game than as an instrument for testing reason. George Coates has installed HyperDodgson, a HyperCard-based animated "dis-orientation" to Dodgson in the lobby of his theater.

an inventor and experimentalist in media. He was one of the first developers of the photographic film technique. I think some of his early work as a mathematician contributed to the development of the first code-breaking machines, forerunners to present-day computers.

We create our productions through intensive six-to-nine-month trial-and-error workshops with hardware, projection systems, software, product developers, and performers. The process is labor intensive and requires too many separate delivery systems and operators to be commercially feasible on a broad scale. But if the various media could be brought together on a single delivery system, and if more research and development could move the production from the monitor onto the optic walls, we would be able to compete aggressively with film and other performance mediums. We can make movies in real time and have human beings interacting with digitized versions of themselves in actual full scale.

We put together a SMARTS group (Science Meets Arts Society) composed of refugees from the space program, Silicon Valley, and other places. We've developed a method for pooling our resources to find where the technology is going to take us next. We don't like to call it *multimedia*. We prefer *mutual media*. Eventually, I foresee all the images — film, sound, animation — developed on the monitor, then blasted out of a lens on the other side of the screen to cover an entire wall or ceiling — a surround kind of affair. Images could be formed to upholster an alcove, and designs added for other parts of the architecture. Change the architecture and change the images to suit. Once we've developed something interesting on the monitor, technology should be able to get us beyond having to bring it back to project on 16mm film. We can do it, but it's cumbersome.

As an artist, I'm interested in emerging technology insofar as it provides an instrument for creative expression. As a producer of large–scale spectacles with a 500-seat theater in San Francisco's Civic Center, I'm interested in

(Coates)
emerging technology insofar as it helps develop audiences willing to purchase tickets to a world of sound, light, and human expression that is a journey of attention.

I generally decline to stage roll-outs, sales presentations, or trade shows. But I did make an exception to introduce Steve Jobs' NeXT Computer at San Francisco's Symphony Hall in 1988. Steve asked me to do it one day, backstage after a performance. He said, "I think you might be the right person to introduce the future of multimedia to the world." I replied, "Well, since I've been doing it for 13 years, I find it hard to argue with you, Steve. But I don't know what I'm doing, and you seem very sure of yourself."

In this regard, I think it's important for us to embrace uncertainty as an ally, and develop ways of interacting with each other without necessarily having a goal or knowing what it is we want to find. Actually, it was a delight working with Steve. I learned from interacting with him.

Let me conclude by proposing a new relationship between creative arts ensembles and the emerging technology industry. I would replace the current Research and Development wings or experimental *divisions* existing in the flow charts of most corporations today with something resembling the university/industry relationship that has proved effective in the sciences. It would work as follows:

Ensembles of creative artists would be assembled as non-profit tax-exempt companies.[17] Their mission would be to explore creative applications for emerging technology and to exhibit, perform, or otherwise present publicly the results of their creative work. Corporations would endow rather than hire or contract for these ensembles, with direct grants of funds and equipment, to freely develop creative applications of available technology. Partici-

[17] 501(c)3 in the tax code

pating artists would design modifications and request changes in the granted technology to suit their interests. The corporations' product development departments would cooperate as needed.

The artists would not be employees of the corporation, but the corporation would reserve proprietary licensing rights to all applications and technology developed. The non-profit arts ensembles would reserve a royalty on future income derived from products or applications developed through their work, and retain the rights to use material and hardware free of cost. The artists would be employees of the non-profit ensemble, and would be salaried through the usual arts funding channels supplemented by royalties derived from successful discoveries developed in this arts/industry relationship. This model has some precedent in the relationship between Yamaha and the CCRMA Institute at Stanford, but is far from reaching anything approaching industry-wide trials.

This relationship frees the artists from the pressure of short-term corporate goals found in current R & D division structures. Insofar as an environment of stress or anxiety is limiting to true creative endeavor, this approach should increase productivity.

These are my main thoughts from having worked in multimedia long before the industry adopted this buzzword and decided to develop the concept and make it really happen. We've been out there trying to do multimedia on a very large scale. We want to work with what the industry comes up with whenever it's available. We will use it in ways that may not be intended. It's not too soon to get started.

■ Abel

It is significant that we happen to be meeting on the night of the Oscar presentations. I moved to California on a spur-of-the-moment decision when

(Abel)
I was eleven years old. When our house burned down in Milwaukee, Wisconsin, my father took it as a sign from God. He packed us in the family Dodge — a little business coupe — and drove straight to California.

We lived literally three doors from Metro Goldwyn Mayer (MGM). I used to hang around there with my Schwinn bicycle, and met the head of MGM's special effects department. He asked me what I was doing there. (Everybody wanted Clark Gable's or Judy Garland's autograph.) I told him I wanted to see how movies were made. You know, how did you do the *Wizard of Oz*, and so on? He was fascinated that I would be interested in how illusions were created and people moved emotionally. He took me under his wing. That was the essence of it. It changed my life.

So, here we are on Oscar night, and somewhere across town they're celebrating the past. In this room, we're forging the future. That's a big difference. A few years ago, I didn't know most of the people in this room. Now I know maybe half — and my life has changed for the better because of it. I know some of these people have been out there for years, starting trends and making much of what's happening today possible: Alan Kay, Nolan Bushnell, Nicholas Negroponte, and others. They were out there long before we were. They've helped to bring the situation to a point of critical mass, where it's all about to change. They have helped or inspired everybody else.

I'm planning a reunion of my old film company. I wonder if I'll have the same feeling then that I have tonight. The greatest loss I felt when I left the film business was the loss of the communal spirit that pulls people together. We've heard about passion and politics, and many wonderful words from the previous two speakers. By God, that's what it's all about!

We are at a point in this society when opportunity and crisis come together. The Chinese pictograph symbols for these two ideas, in fact, are the same. It's not surprising. I don't really know when I began to understand this fusion and the excitement that results from it.

I lived in the sixties. I've been in Vietnam. I've been in Selma. I've been just about everywhere. I was with Robert Kennedy (filming a documentary) when he was assassinated. Rafer Johnson, one of his bodyguards, was my roommate when I was a student at UCLA. After *The Making of the President*, I left and got a job teaching at the University of Southern California.

One evening, I decided to show my students *Triumph of the Will*, the greatest propaganda film ever made, along with a film about Americans in Vietnam, called *The Anderson Platoon*. I asked the 200 kids in attendance, "What is the Vietnam War?" After a long pause, a hand finally went up. I recognized the fellow from architecture school, where I'd also taught. He said, "The Vietnam War is what happens on CBS between 7:00 and 7:30 at night."

This was in 1969. It was a moment of great insight. Walter Cronkite would say, "And that's the way it is. February 19th, 1969." The program would end, the commercial would come on, and for most people in the country, the war was over until it started up again at 7 o'clock the next night.

I began to realize that the world is different when we have some power. I have to admit that when we work, we work from fear. The fear is that we're going to let people down. The fear is that we can't deliver everything we say we can. But we push ourselves beyond it. The fear is that we have a great opportunity and we won't make the most of it. We're driven by fear. We're also driven by the reward. We're driven by the idea that maybe we can entertain people and be exciting.

When we began to work in this medium, my associates and I would think, "Are we crazy? We believe we know what this is supposed to be about, but we don't." So we went and did a *Guernica*, and showed it to people like John Sculley, who is sitting here in front. I remember the time I went to his office. He really liked it. That was a wonderful moment, because it showed me I wasn't crazy — or, at least one other guy was as crazy as I was. He agreed with me. Then others did too.

(Abel)
When I worked for Stanley Kubrick on *2001*, he started the first day by saying, "The next several weeks I'm going to ask nothing but dumb questions, because I'm going to make the greatest special effects movie ever made, and I don't know how to do it. In the end, of course, it'll read, 'Written, conceived, directed, and produced through the genius of Stanley Kubrick.' But I'll never be afraid to ask a dumb question."

Towards the end of the project, Kubrick hired Alex North to write a very expensive score being orchestrated for the London Symphony. Kubrick hated it. Poor Alex (a blacklisted, Oscar award-winning writer of music) was in a body cast. He had broken his back. Stanley kept saying, "I hate this. I'm not going to use any of it." One of my associates, who was director of special effects, kept saying, "Well, Stanley, just let it go, because the orchestra alone is costing us lots of money every day." But Kubrick would only say, "I can't do it to him. I can't do it."

He finally did throw out the music score. The next morning we got a call at 5:45 a.m. Kubrick arrived with shopping bags filled with classical musical pieces. He said, "When I show the reel with the space stations on it, do a needle-drop." So we put on *The Blue Danube* . . . and on and on and on. It was all done in a period of about 4 1/2 hours that morning. Stanley said, "Either people are going to think I'm the craziest guy who ever lived and I will never direct a film again, or they'll think I'm a genius."

Well, *2001* is now history. But what was it until we saw it? I suspect all of us wrote our speeches tonight sitting here. We didn't really know what we were going to do — and didn't want to know — until we started doing it. What was *2001* until we saw it? What was *PacMan* or *Pong*? What was Impressionism, or James Joyce's *Ulysses*, or Charlie Parker until we saw them?

The people in this room are going to be among those who invent the change that makes a difference. The companies of John Sculley, Lucie Fjeldstad, and

others here are going to make it happen. We have a chance for remarkable change. (That's a line I learned from John Sculley.) There's a great opportunity. This country is suffering tremendously. We sit and watch television. But a fusion is occurring. The computer and television are coming together. The issue is one of content, and one of politics.

I saw a Laurie Anderson concert a couple of weeks ago. As she was finishing the concert, she announced, "This performance is dedicated to Abbie Hoffman, who dared to cry *theater* in front of a crowd that was on fire." I'll never forget that line. For me, having lived through the sixties and Chicago, those words were right on. We have to create theater, because we have a world and a crowd on fire that needs it. We must be able to take bold steps. In all the years I've worked, and all the businesses I've been in, I have yet to find a situation where a bold step has not led to something quite fantastic.

A week ago, I showed our most recent work, *Ulysses*, to someone who said, "I hate this. It's everything that's wrong with this medium you call multimedia." Now the greatest fear an artist has is for someone to say, "I hate this." But I had enough control, after all these years in the business, to let the person rant and rave. After ten minutes, I said, "All right, now, are you done? What are you doing? I've talked to you on the phone for several weeks, and you never revealed any emotion, feeling, attitude, or commitment about anything. But you just gave me a ten-minute diatribe because I caused you to think. Even though you didn't agree with me, you thought — and you had a feeling." Now, if we could do that with the 45 million kids in America who are dropping out of school at the rate of a million a year, we've got something going.

My critic was especially incensed by one of the sequences in *Ulysses*. It was from the German propaganda film *Triumph of the Will*. When I showed that film to the students at USC, they loved it! They wrote essays saying, "Thank you for showing us the other aspect of Hitler. He wasn't such a bad guy." I

(Abel)
thought, my God, what have I done? But I won't burn films anymore than I condone Adolf Hitler's burning books. We've got to take risks.[18]

We were all burned out a few weeks ago after appearing at a series of computer conferences in fast succession. But we had an obligation to show *Ulysses* to a group of eleven-year-olds to whom I had personally made a promise. So we did. The last two sequences we ran were about heroes — from Joan of Arc and Amelia Earhart to Martin Luther King and the man in front of the tank in Tienanmen Square. It took about 2½ minutes.

Just before running these final sequences, I ask, "What are heroes?" There are all boys in the front. The first boy, who's wearing a Michael Jordan T-shirt, says, "Michael Jordan." The second says, "Magic Johnson," the third, "Joe Montana. He won the Superbowl; he's going to Disneyland; he made $50,000." The fourth, "José Canseco." I say, "Okay, we've heard from the boys. How about the girls?" And I get Paula Abdul, Janet Jackson, and Madonna. I say, "You know, I just learned something here. Your heroes are formed by television, aren't they?" They say, "Right." We're rolling a couple of Sony high-eight videos, recording all of this.

So we end the sequences with this man confronting the tank in Tienanmen Square, whereupon the boy in front wearing the Michael Jordan T-shirt says, "I guess you gotta be more of a hero to stand in front of a tank than to slam-dunk a basketball." And I think, "Thank God, maybe we are doing the right thing after all." I'll go for that kid. I don't care about the guy who says, "It's everything that's wrong with this medium." I don't know what this medium is; we're still trying to form it.

Then a teacher gets up and says, "You know, this is like a giant onion; you keep peeling it away, layer after layer, and you cry. But you don't cry

[18] As put by jazz musician Thelonious Monk, "Sure I take risks. The only cats who are worth anything are the ones who take risks. Sometimes I play a tune I've never even heard."

because of the catalytic effect a real onion has. You cry because you realize these kids, whom we give our hearts to every day, are going to peel away these layers and find something of themselves inside. And you also cry because maybe that onion won't get made or produced.

What's the down side? A million kids dropping out of school every year because they aren't motivated or turned on. That's going to cost this country $265 billion a year in lost taxes — to look at the economic aspect. Education is a $3-to-$4-billion-a-year business. The *Wall Street Journal* says training alone is $219 billion. As adults, the easiest thing to say is, "I don't know" or "I don't want to know." But kids are the messengers we send out into the world. They'll be the ones most affected by what we do and say here.

It always comes down to the struggle. God only knows what we're going to discuss in the next day, but it's likely to be about politics and struggle and fear and commitment. The worst thing we can do is stand still.[19]

I'm more at home with this group this evening than any group I could possibly be with. I hope we fight, hassle, and carry on, but the biggest fight we have is to *just do it*.[20] *Just do it*, one step at a time. Max Whitby does it. Alan Kay does it. Robert Winter does it. Bob Stein does it. And most of the people in this room *do it*. The artists are here to help you *do it*. Trust us. We've never missed a deadline or a Superbowl. There's too much at stake. Just ask us. It's content. It's overcoming fear. To borrow a line from Stewart Brand and Nicholas Negroponte, we *are* inventing the future.

If we all get together, we can change anything. A year from now, two years at the latest (that's a deadline), we will come back here and talk about how we began to change the world. We can do it. We just have to not be afraid to say, "Maybe I blew it." It all comes down to taking risks. Give us a chance and we'll change the world.

[19] As Satchel Paige, the celebrated black pitcher, said, "Don't look back. Something might be gaining on you."

[20] Nike television commercial.

Jack Sculley, Moderator
Lucie J. Fjeldstad
John Sculley

IBM and Apple are the two largest computer manufacturers devoted to making multimedia succeed. Within these companies, Lucie Fjeldstad and John Sculley are prominent promoters and spokespersons for the cause. In presenting a business perspective on multimedia, Mrs. Fjeldstad appeals for the diverse players assembled to work together to advance the field and ensure beneficial applications of the technology in education and other social areas. John Sculley, introduced by son Jack who arranged these first two sessions, fulfills his son's request for a very personal perspective — in the nature of a fireside chat. Sculley finds problems with the label "multimedia," preferring "interactive media," but concedes that we may become more comfortable with "multimedia" as we begin to understand its meaning better. The two speakers are as one in urging that the technology be taken from the hands of technologists and made widely accessible to artists and content creators.

■ Jack Sculley

In the first set of talks on *Pushing the Envelope*, three artist/innovators who are blazing trails with the new media technologies gave us their personal perspectives on what they've done, where they'd like to be heading, and what they feel is needed to get there. In this next set of talks, called *Making It Happen*, we've asked two business leaders, who are tremendous innovators in their own right, to tell us what it's like to form partnerships with artists and develop a sense of collaboration. This seems essential if multimedia is to succeed. Yet, traditionally, artists, technologists, and business leaders have tended to hold each other at arm's length. It takes trust and friendly discourse to bring their different backgrounds and viewpoints together to *make it happen*.

■ Fjeldstad

First, I want to thank the people who arranged this Roundtable. I think it's absolutely critical that we meet. We're experiencing a paradigm shift in multimedia. The momentous journey we're on is about to accelerate. We must work together to guide the rate and direction of this change. We need one another. When you need one another, you trust one another — and the barriers go down.

I want to talk briefly in general terms, then lay out some challenges that lend themselves to team effort and action items. I referred to a *paradigm shift*. My hat goes off to Apple for its role in bringing about the paradigm shift in technology we know best — the personal computer. What the personal computer did to personalize information processing for many of us in the 1980s will be dwarfed by what multimedia will do for all of us in the 1990s. Multimedia will not just drive hardware and system software. It will absolutely change the way we think, the way we work, the way we learn. This is why our meeting together now is so absolutely critical.

There was a philosopher named Lao-Tse in the fifth century B.C. who said, "If you tell me, I will listen. If you show me, I will see. But if you let me

experience, I will learn." I've been in technology a long time. I know the value of first-hand experience. I also understand the position of the innovators. I've come to pretty much the same conclusions as Robert Abel, for example, but from a different perspective.

Frankly, I'm scared to death about the future of our country when I look at the number of uneducated, illiterate people we have. As we move into the 1990s, we'll require fewer blue-collar jobs, many white-collar jobs, and many jobs with collars yet to be colored. Workers will need to learn and continue to relearn. It's not only educating the young that's critical, but also retraining the knowledge worker.[21] Multimedia can help. Kids today spend 20,000 hours in front of a television set before they're 16 years old. Television is the way many learn. It's the way they think. As we marry the worlds of the television and personal computer, content is the *hole* — and the *whole*. Content is what's missing and it's what multimedia is all about. It's the future of multimedia.

Multimedia, to me, energizes the senses: sight, sound, and touch. Voice will be critical to the many people who can't read, and touch to those who can't type, to provide them with the ability to communicate. One challenge is to change the way we think about applications and computers. Computers are going to have to communicate with people, rather than people communicating with computers. People from the world of art, books, magazines, and public welfare must change their attitude about computer applications to help us move into the multimedia arena. We're fairly close. The hardware and system software should be ready within the next few years.

Knowledge workers are going to need on-line, on-demand, just-in-time education and training. We've got to provide them with the right tools at the right time. They'll have to be able to gather data and weave it together in patterns according to the way they learn or think. Multimedia does more

[21] Knowledge workers are those who work with information as their primary concern.

(Fjeldstad)
than energize the senses. It allows people to move through phases — looking and learning the way their minds work — using sound, sight, touch and analysis. As they proceed through the data — and by the way they proceed — they may discover things they never knew before. Finding ways to provide the right tools for the knowledge worker, and the skills to develop these tools, are key. We need computer programmers — although eventually getting them out of the way would give us more freedom and get us faster to where we need to go.

Corporations must invest in people. Corporations spend a great deal of money in physical capital, but not enough in human capital, despite the vast amount they devote to training. Current training assumes people can read and learn. This is not necessarily true. How training techniques are rebuilt with multimedia will be critical. IBM does well in this respect. It is the second largest user of multimedia equipment and techniques in training.[22]

We must introduce multimedia techniques into education so as to encourage learners to be in control of their own learning. The concept should be students as explorers, allowing teachers to be resource managers. This scares a lot of teachers. We need to train teachers so they can become part of the solution. We never want to leave them out. They are a critical element.

Another challenge is to apply these technologies to critical social programs touching on lifestyle, literacy, and self-esteem. Applying an impersonal technology like multimedia to deal with very personal topics like drugs, AIDS, teenage pregnancy, and welfare will create political problems, but is necessary to provide meaningful education to the masses. We may be surprised to find people going up to a kiosk or personal computer by themselves to learn about AIDS, in lieu of going to a human counselor or asking for information in a classroom. We're going to have many such surprises.

[22] The largest user of multimedia equipment in training is the U.S. government.

To realize these possibilities, we need to reduce the cost of the technology. By the time we're back here in a year or two, I think we'll have seen dramatic reductions in this component of the expense. The primary cost will not be in the technology, but in its application. How multimedia applications are produced will become very critical.

Eventually, personal computers mixed with electronic components are going to be a normal part of everyone's life. As we move toward voice input, the technology may migrate from the desktop to the wrist, but however it evolves, it will need to provide easy access to information in a fast-moving world. What will the repositories for the data be? What will be their design? How do we access the information? How do we control it? These are some of the technical questions that must be addressed. We want to work with you in answering these questions.

As a semi-inventor in my own right, the excitement for me is in the journey itself. We have already started on this journey. I look forward to working with you. I think it's imperative that all of us work together to develop the multimedia revolution of the 1990s.

■ John Sculley

I remember as a young boy being absolutely fascinated by television. But my first exposure to mass media came from radio, not television. I was really more of the radio than the TV generation. Back in the 1940s, people would sit around listening to very large radio consoles. Around 1947, I remember seeing a radio labeled "adaptable to television." It had a little spot where you could plug in the component that was supposed to turn it into a television. It never happened.

I did not see my first television until 1948, at a department store in New York City. I remember to this day the thrill of watching a large crowd of people standing around this tiny black-and-white 10-inch screen. It was basically

(John Sculley)

baseball games and a few shows in those days — no daytime television except when a sports event was taking place.

Watching everyone standing around Bob Abel's demonstration today with their eyes glazed — though this is a pretty knowledgeable group — gave me the same sort of tingling feeling. We all knew we were looking at something important, but we were not totally sure exactly what made it important.

It's still too early to be able to define what's going to make multimedia special, yet we know it's the beginning of something extremely significant. My background was not in technology, though I had fun building television sets and designing systems. My background was in art, design, and architecture.

When I first came to Apple, Steve Jobs introduced me to the initial Macintosh with great pride. But I was underwhelmed, because to me it looked like the 1948 television I'd seen some decades before, with its small, 9-inch, black-and-white screen. Steve saw it in a very different context. He quickly pointed out to me that this was just the beginning of what was going to be an extraordinary revolution with personal computing.

Some years later, in 1986, Alan Kay took me under his wing as a don does a student, and led me through the laboratories of Apple and the universities. He gave me many things to read and introduced me to computer technology. At that point, I really didn't know very much about computers. From this came a mythical product that I described as the Knowledge Navigator.[23]

The Knowledge Navigator is based on many things to which Alan led me. One of the most important was the observation that it takes about fifteen

[23] Knowledge Navigator is John Sculley's projection of our use of computers in the 21st century. Sculley worked backward from this vision of the future to imagine what technologies would have to be developed in order to get there. His concept is illustrated through a videotape of a professor in the future using his personal computer to prepare a lecture.

years for a new invention to go from discovery to being fully commercialized, whether it's a simple electromechanical mouse or a sophisticated object-oriented program. I realized that the ideas in the laboratories in 1986 were what would probably be appearing in commercial products at the turn of the century, depending on how far they were into incubation.

What Alan and I tried to do was identify the most promising technologies. The Knowledge Navigator had roots all the way back to Dynabook, one of Alan's early ideas. After conceiving the vision, we decided to give it form. Through the use of special filming effects, we expressed the Knowledge Navigator as it might appear early in the 21st century. This gave us a future context from which to look back to the late 1980s and early 1990s to see the potential for personal computers. It became pretty clear that computers were going to become more personal, interactive, and communications-intensive, and be very rich in media and functionality.

About that time, Apple Fellow Bill Atkinson was working on a product he called *Wild Card*. When he showed it to members of the Advanced Development Group at Apple, they asked him why he was wasting his time. Alan told me, "It's really interesting. You have to see it." When I did, I said, "Hey Alan, that's the missing piece! That's the navigation tool we don't have in the Macintosh for the Knowledge Navigator!"

So we encouraged Bill. We sponsored him. I guess it was the only time I've ever overridden the engineering community at Apple. I said, "We will do this project, whether you want it or not." The requirement we placed on Bill was that he have a programming language built into his system that non-programmers would know how to use. The real future, we felt, was not with technical people, but artists. We wanted to get *Wild Card* into the hands of nontechnical people. Prior to its release, it was renamed *HyperCard*. The programming language was called HyperTalk.

(John Sculley)

As we look around for guidance on where we ought to go, we can examine what has already happened, not just with the television industry, but with an obviously better example, the film industry here in Hollywood. Silent films were successful to a point, but the talkie changed suddenly, completely, and forever the way we look at movies. The following decades brought many other innovations — color, 3-D, larger screens. None ever seemed to have the same importance as talkies.

Computers are not even at the talkies stage yet. We're still in the age of silent machines. Two simple ideas, sound and motion — the powerful elements of movies — have yet to be fully expressed in computers. It's very easy to get caught up with the other dimensions of multimedia — the realism, the color, and the rest — but we haven't even gotten sound and motion well implemented yet. When we do, it will help set the next direction for multimedia.

To return to a problem Lucie Fjeldstad mentioned, something like 20 percent of our population is illiterate. Though we talk about it, I think it's very doubtful that we'll ever actually teach these people to read. Furthermore, about 70 percent of the people in this country get 100 percent of their information from television. They've been reared on television. Whether we like it or not, that's their source of information. I think it's eminently reasonable to aim for a new medium that will help not only the illiterate people understand, but also the rest of the population, which is growing up without the same book experience older generations had. This new medium will not just be text or graphics, but a combination of text, graphics, sound, and motion — with the realism of television as part of it. It will not have as much to do with teaching as with understanding. Personal computing has to do with building models. Television has to do with passive watching. With interactive media, the basic purpose is going to be understanding.

Much of the success of personal computers has been in activities people were doing before there *were* personal computers. Although there are thousands

of applications, about 75 to 80 percent of the usage of personal computers is word processing and spreadsheets. I recall doing spreadsheets by hand with an electromechanical calculator and long green worksheets many years ago, and I remember typing on an old typewriter in college. These are familiar experiences. They are done better on personal computers and make logical starting applications.

My sense is that the earlier successes with interactive media are again going to be in familiar activities. One concept that adapts well is the storyboard, a familiar tool to anyone who has grown up in advertising or film production. With the storyboard, we can show visual scenes sequentially and deal with a dimension we don't think much about in computers: namely, time. Word processing doesn't deal with time, nor does a spreadsheet; multimedia must. Time management is essential to multimedia.

What I hope we'll see are intelligent storyboards with tools that enable people to navigate through thousands or even millions of frames, scrolling in any direction — up, down, sideways, and into the time dimension — with some intelligence built in, to handle routine operations. A big issue in computers today is how to store more information, increase memory size, and obtain greater capacity. That's not the issue at all in multimedia. The issue there is not storing information; it's finding it. It's not teaching or presenting; it's understanding.

The paradigm shift that Lucie Fjeldstad is talking about is already taking place, although it's difficult to find the right label to describe it. The problem with the term *multimedia* is that it's at too high a level of abstraction. I don't know what it means. Is it a market? Is it a technology? *Television*, which connotes vision and communications at a distance, is more descriptive than *multimedia*. Maybe we don't have to change the name. Maybe it's just a question of learning what *multimedia* is as we start to experience it. Those of us first seeing television in the late 1940s did not really know what *it* was.

(John Sculley)
All we knew is that we were seeing something happening in real time. We certainly didn't know what its social consequences would be. It's only now that we're slowly beginning to understand.

One example of the effects of television is what's happened in advertising, where I worked back in the 1960s. We spent a great deal of time here in Los Angeles measuring the effectiveness of television commercials. We would measure the amount of moisture on the fingers of subjects to determine their level of interest. We would watch the slow build-up, then watch the level dip, then watch it build up again, and maybe dip again. Where it dipped, the commercial had to be fixed.

These were 60-second commercials. We know today that people who have grown up with MTV, video games, and the totally different experiences coming from a whole generation of television, learn in about 6 or 7 seconds, not 60. A 60-second commercial is a total waste of time. Did the people change, or did our understanding of the technology change? I don't honestly know, but I do know that people learn in 6 or 7 seconds.

Another example is the game of tennis. As a kid, I remember watching people play tennis. It was a long game, with nice, clean strokes and everyone dressed for a relaxing afternoon. That isn't how the game is played today. It's played like an attack game in the video arcade. It's all reflexes.

From a sociological standpoint, the impact of television has been incredible. It has changed the way people think, the way they do things. It's redefining sports; it's redefining lives. Why is interactive media — or multimedia — going to be any different? Thirty years from now we'll look back and explain multimedia with as much clarity as we explain television today.

For now, we're all scratching our heads, each of us trying somehow to open up an intuitive understanding of what's happening from personal experi-

ence. Quite frankly, I don't think any of us know at this point. I think we're all sort of skating around what we recognize to be important. In two or three years, we'll surely know more about it than we do today.

What we can say with assurance, from a technical standpoint, is that the technology will get better and cheaper, fast. There's no question about this. Bob Abel is running his demonstrations on about $15,000 worth of equipment. No one realistically expects people in large numbers to go out and buy $15,000 worth of equipment. But, in a few years, it's not going to be $15,000; it's going to be a few thousand dollars. In the home electronics part of the market, it may be under $1,000.

Where is this market going to begin? There are three or four places to watch. Entertainment at the consumer level is probably where it will develop fastest. It's here where the equipment is least expensive. The content — which will be the real cost — can be amortized over the largest number of units. My guess is that entertainment will be one of the first successes. But this will have less relevance for the computer business than for the consumer electronics business.

The second area of application to watch is information access. It has a way to go. From a technological standpoint, it's very impressive to have an encyclopedia on a CD-ROM disc, but it's even more impressive to have a book to walk up to, pull from the shelf, and browse through. Generally, we can still find something faster and in a more interesting way from a book than from a disc. Though the technology is not yet to the level of the book on the bookshelf, it will happen. Information access will become important, but it will take longer than entertainment. It's got to provide more value than just an encyclopedia on a disc.

The third area to watch is productivity. It's one of the more interesting application areas for us in the computer business, because it involves providing more support for what people are already doing with personal computers.

(John Sculley)
For example, instead of just giving a draw program to people who do not know how to draw, we'll give them a program that shows them how to use the draw tools — with illustrations. The problem is, no one will build such applications until there's enough of the necessary hardware installed to run them. This is the chicken-and-egg quandary. It will be too expensive to build multimedia capabilities into all base machines until the use expands, yet developers won't build these applications until enough base machines have the necessary capabilities.

We all know it will eventually happen. It's a question of when. I've been considering multimedia for about five years now. Each year, as I get more experience with it, the market seems a little further out than it did the previous year. Two years ago I thought it was two years out. Today I think it's probably three years out.

That doesn't mean there aren't great products already available. Apple has some, IBM has some, and others do too. Much interesting content is being demonstrated, and it gets better every six to twelve months. But the really large market that's going to significantly change the way people do personal computing is probably still three years off. With entertainment, it may be sooner; with education, it may be further out. Not that educators don't want it. They'd love to have it. But who's going to pay $500,000 to distribute multiple versions of *Ulysses* and *Guernica* when there are no machines to run them? It will take time for hardware prices to continue to come down, for the entertainment industry to popularize multimedia, and for computer vendors such as Apple, IBM, Microsoft and others to strengthen the software architecture underlying the concept. My sense is that a great deal will be accomplished in five years, but only a limited amount in the next year or two.

Remember, we are dealing with a brand new media form. We don't always appreciate how significant a new media form can be. Think what it would be like for someone from the 18th century to watch a scene from a contemporary film. The scene shows someone talking, cuts to someone else, zooms

out to a wide establishing shot, cuts to a totally different scene that happened three days before in another part of the world, then cuts to two other characters who weren't in the scene thirty seconds ago. The visitor from the past wouldn't have any idea of what was going on or how to follow it. Yet, for us, it's completely intuitive. Multimedia demos are not. We're still looking at buttons, windows, and links — relatively new nomenclature for us. Five, ten, and twenty years from now, many of these things — or other things we invent — will become just as intuitive as cuts and zooms in the movies.

We need to look at the possibilities, not in our context as adults, but in the context of young kids. This is why I think Alan Kay has been on the right track in studying kids. They provide a much better clue. Kids aren't contaminated; we haven't spoiled their way of thinking yet.

There are some extraordinary opportunities ahead. I prefer to call our subject *interactive media*, to emphasize that we're *doing* something with the media. What makes interactive media exciting to me as a means for understanding is that it has the modeling capabilities of personal computers, along with the watchability of television, plus one other thing — we *do* something. Psychologists learned in the 1960s that people remember far more of what they *do* than what they see, read, or hear. The fact of doing something is far more powerful than watching or listening or reading. The ability to combine doing with watching and model building — invoking some intuitive new media language that's enjoyable to use — is extraordinarily powerful.

This is the potential. It won't be designed by the Apple Computers of the world. We aren't the key. The real key is the content people and the artists. The biggest challenge we have is to move the technology out of the hands of the technologists. They will make a mess of it. We've got to put it into the hands of the artists. If the group here can do something to bring this about, then we will indeed have a chance to change the world a little.

Ching-chih Chen, Moderator
Alan Kay
Richard Lanham
Bernard Luskin
James Catterall

It was not easy to call the Roundtable to order on the morning of the second day. Participants getting acquainted or reacquainted were absorbed and animated in conversation. We were loath to interrupt them. Even more difficult were the time and media restrictions we had to impose on presentations. With little more than an hour per session — half to be devoted to general discussion — panelists had only seven minutes each for opening remarks, which did not allow for slides or video. "Seven minutes!, " exclaimed Alan Kay, when we told him the night before. "I can make just one point in seven minutes." "Alan," we advised, "make it a good one." He went us six better at the session, producing seven points for seven minutes. In an end run around moderator Ching-chih Chen, Kay called out as he began his final (and best) point, "Sorry! You can't stop me now." Still, there seemed to be enough time for all panelists. Richard Lanham offered his own seven points — in the form of questions for the university — plus three concluding generalizations. Bernard Luskin made a plea for a standard digital format, and James Catterall commented on the reasons for technology's past failures in education. There was even time for the meeting's first brouhaha, a disagreement over open versus common architectures, ignited by Luskin and fanned by his associate Gordon Stulberg. The well-meaning moderator was rebuffed a second time as she sought to move things along and maintain decorum. "Don't stop it," objected combatant Nicholas Negroponte, "when it's getting interesting." It did get interesting, although not the way the parties involved might have hoped, with insights from the exchange arguably having more to do with industry sociology than open or common architectures.

■ Chen

To this distinguished group it is not necessary to stress the educational potential of multimedia technologies in the coming decade. There is a fundamental change taking place in educational computing. A new crop of software developers, educators, and course designers is converging to bring together computer software with video, sound, music, voice, and text. The results are powerful new teaching tools unlike any we have seen before. The fading electronic boundaries among different media invite a reevaluation of how knowledge is recorded and disseminated, and learning achieved.

Yet, we are still far from reaching our goals. As we enter what has been called a *visual information age*, we are required to develop our future in education without viewing it from the distorting lens of the past. But how is this accomplished when educators at all levels are not prepared, or even informed about the technology?

I know Alan Kay is right to start with children, but what about others? Many agree there is need for a fundamental shift from providing text-based information and passive teaching to providing media-based information and individualized and interactive learning. Yet the question remains, how can it be made to happen?

The greatest potential of multimedia technologies in education lies in their effect on the way we learn and understand. Unless our applications can achieve such a change, all the technological glitter is really little more than show business. Like the latest fashion, it can come and go without any lasting effect. Technology is only a tool, not an end in itself. We must use the tool to reach our goals.

My own personal involvement with *Project Emperor I*, starting on a shoe-string budget, has grown to the point that in the last eighteen months I have spoken with audiences from over twenty countries. It makes me realize that

these technologies can indeed change how information is demanded. My audiences, in short order, developed a taste for receiving information on-line in interactive and non-linear fashion.

Professor Robin Yates, an expert in archaeology who consulted with my project, said to me before he joined Dartmouth,

> *My God, Ching-chih, you are changing my teaching style! My teaching for the last twenty years has consisted of mainly lecturing with a few slides and films. Now, any time there is a need to illustrate a comment or have an expert's view, it can be made available right away. That's so powerful. The only problem is, I don't have the equipment to run the application, even though I am a consultant to the project.*

We should not forget that lots of educational departments at all levels still don't have access to the necessary hardware.

Multimedia technology provides the tool to weave comprehensive, diversified, and associated subject knowledge together. But an application is not likely to be judged by the technology or delivery platform it uses. It's going to be judged by how relevant and complete it is, and how well it complements teaching, reading, and classroom discussion. Many of you are working hard to develop consumer-oriented applications. Rightly so. We need a mass market. But what about education? Who's going to train the educators? Who's going to train the people who must implement the paradigm shift into a new kind of teaching?

These questions may help start the discussion. As moderator, I will now ask Alan Kay to give his views. Please try to keep it to seven minutes, Alan.

■ Kay

Since I have seven minutes, I will make seven points. The first is, I find it curious that we don't get to use media for our presentations here. We're basically back to 10,000 B.C., sitting around a campfire using language. If that works well enough, maybe we should have a conference with a different topic. It may be a little bit of the university attitude, "Well, let's study the stuff, but good heavens, no — let's not use it."

The second point is, my work with children and some adults over the last 25 years tells me that technology does not help much in education. The way to produce musicians is not to put a piano in the classroom. The music is not in the piano. At best, a piano is an amplifier for a person's musical impulse.[24] We have to be very careful when we try to apply technology to people.

On the other hand, musical instruments can be shiny and attractive — like the *76 Trombones*. We should be able to use that attractiveness. But it can only be done with a curriculum that makes sense without any technology at all. Working with a student's body and mind, the curriculum should be designed as though there is special media associated with it. Once that is accomplished, the technology can be added to amplify certain actions.

Music is a perfect case in point. You give up a lot when you play a piano, but you get to play more than one note at a time, something not possible with the voice alone. Because the piano is one of the least expressive instruments ever made, musical expression with the piano must be done by tricking people.

The important technology paradigm is not *personal computing* but *intimate computing*. My old friend Nicholas Negroponte was one of the very first people in the 1960s to identify this notion of intimacy. One of his books has a dedication with a wonderful double-meaning. It reads, "To the first com-

[24] A survey by Casio in the early 1980s showed that piano lessons turned 9 of 10 people away from playing music. Only 1 of 10 felt amplified by the piano.

puter who can understand the gesture." I like to think he meant understand, not only the physical gesture, but also the gesture of having a book dedicated to it.[25] (*Negroponte indicates he did intend both.*)

While we don't have intimate computers yet, we do have gadgets like this wonderful little phone here. I can make calls to human agents now. In a few years, I'll be able to make calls to computer agents to do things for me. Another gadget I am holding in my hand is particularly poignant. It costs $299 at Sharper Image. This is the King James version of the *Bible*, run by a 16-bit microprocessor in hypermedia form. It performs searches and finds correlations. It is a nice checkpoint for the *Gutenberg Bible* in 1454.

So the technology's going to be intimate. Multimedia's not going to be at the center of that intimacy, but will be like a planetoid orbiting around it. That's one of the main points I want to make. The way to focus on multimedia is not to look at it directly, but to understand what it means in the context of computer simulations and modeling.

My third point is, for a school to work, the parents must be directly involved in the process. The parents set up a value system that makes what's happening worthwhile. A school does not work because of its great technology.

Our achievement at Xerox in dreaming up the ideas that led to the Macintosh was to transcend the existing value system about computers. We put a little music in the Macintosh, and the result is 3 million people are now playing *Chopsticks*. That's what's done on the Macintosh. Playing *real music* is much harder.

My fourth point has to do with the nature of the brain. In dealing with education, we must pay attention to the learner. You cannot stuff knowledge pellets into empty vessels. The only way to introduce knowledge to people is to give them a reason to want to learn.

[25] Negroponte, *The Architecture Machine* (See Bibliography).

(Kay)

McDonald's would never run a print ad that read, "Eat Big Macs and you'll get better looking." In English, that would be rejected immediately. It's not a plausible proposition. What is done instead is to run photos of good-looking people eating McDonald's hamburgers. A completely different part of the brain makes a weaker inference in the desired direction, associating good looks with McDonald's hamburgers. That works because the brain is not homogeneous or unitary. We think with different parts of the brain. One part of the brain may even believe something is true if it rhymes. If we hear, "A Big Mac and fries will reduce the size of your thighs," a part of us says, "Hmmm, I wonder about that (especially in Southern California where people worry about the size of their thighs). Maybe I should get one and see."

My next two points are important general questions about the process of education. When we put students into a learning situation we must ask, what parts of the human mentality do we want to affect? What are they learning, and what are their mental structures after they have learned? Students do not learn from multimedia; they learn from television! If television is having them learn the way people learned from stained glass windows in the great cathedrals, it is simply restoring a medieval practice. *Learning*, in and of itself, should not be the goal. People learned propaganda in Nazi Germany. We have to ask what students are learning, what parts of their brain do the learning, and what their mental state is afterwards.

The other general educational question is when should the material be easy and when should it be hard? The material is easy when students already have the needed structure to assimilate it. Sometimes we want it to be easy so students will have confidence and consolidate. But sometimes it has to be hard. We want them to climb, construct, and change their mental structures. The educational environment has to be challenging. The real question is, how do we present the challenge?

My final point has to do with this notion of challenge. [*To the moderator:* Sorry! You can't stop me now.] Psychologist Mihaly Csikszentmihalyi, author of the book *Beyond Boredom and Anxiety*, had the idea of studying the effects of ability versus challenge in autotelic activities like chess playing and rock climbing[26]. What he found was that subjects with greater ability than the challenge they encountered tended to get bored, whereas those with less, tended to get anxious. Plotting ability on one axis and challenge on the other, he called the wedge around the 45-degree line, where ability and challenge are nicely balanced, the *flow* experience. The region to one side of *flow* was *boredom*, the region to the other side, *anxiety*.

The idea is that the experience gets better as we climb the wedge. That is, as our ability and the challenge increase, the flow becomes more intense. But moving too far out in one direction or the other is a problem. If the wedge were just a line (or very tight), we would constantly be jumping over its boundaries, falling out of flow. As we increased our ability, we would get bored; then as we added to the challenge, we would become anxious; then we would get bored again, then anxious again. So we want to widen the wedge. This is a design goal for any kind of learning situation, whether in building a computer interface or structuring a classroom situation.

One way to extend the flow into areas where challenge exceeds ability is by making the environment safe; in effect, inserting a safety buffer that widens the flow wedge into the anxiety region. I go to a music camp each summer where amateur musicians play difficult material, like Mozart piano quartets. It is a safe environment for nonprofessional-level players who want to play professional-level music. The camp increases the challenge for us while cushioning the consequences.

How can we widen the flow wedge when our ability exceeds the challenge? We can heighten awareness. By managing to notice more of what's going on

[26] Csikszentmihalyi, *Beyond Boredom and Anxiety*, Chapter 4 (See Bibliography).

(Kay)
we can extend the flow experience into the region of boredom. Media is a way to accomplish this expansion of awareness. We set the challenge when we decide what the content should be.

That pretty much sums up how I think about learning. I personally do not want to go back to the Middle Ages, nor do I think simply putting the knowledge of the world into television form is a good idea. As my friend Neil Postman pointed out, images beg to be recognized, words to be understood. We can get people to recognize things by showing them images. But much more than people who can recognize things, we need people who can think and understand.

■ Lanham

Assuming we are all agreed that multimedia is going to save the world, I will declare my interest in the subject through an illustrative anecdote:

Once upon a time, there were two professors who went to a conference. When they had listened to papers so long their behinds fell asleep, they decided to take a walk, whereupon one turned to the other and said, "You know, I've discovered a secret for saving the world." His companion smiled and said, "Right, sure, so have I, but the President won't listen." "No, no, I have a *real* scheme for saving the world." As the first professor talked, it became clear that his was a plan which really *would* save the world. Just when the plan had ripened into what, here, we might call an *action program*, the two professors noticed that a third person had suddenly joined them. "Who are you," they inquired, "and how did you get here?" The newcomer replied, "I'm the Devil." "Oh, you've come to spoil our plan." "No, quite to the contrary. I'm going to organize it for you."

I confess I'm interested in organizing this multimedia world in what the great American critic Kenneth Burke called the bureaucratization of the imaginative. When Martin Greenberger asked me to talk, I thought I would

be giving a fifty-minute lecture, that being the standard unit of intellection in our domain. So I devised a plan to save the world through multimedia, and wrote it out. I was emboldened in this task because once before I had saved the world by creating a print literacy program, which I ran at UCLA for seven years.

Then Martin told me I had only seven minutes. So I took my points and summarized them as questions for the university. The university must deal with such issues if it is to assimilate the world of volatile text.

First, what happens to cultural authority in a world of electronic media? I've spent my life teaching Renaissance texts. The purpose of the Renaissance was to edit and fix canonical texts so they would never change and could function as a cultural reference point. The whole structure of cultural values built on top of this idea is knocked into a cocked hat by electronic media and volatile text.[27] Where do we go from here? Cultural values and the whole system of academic advancement is at risk. As you know, academics are paid not with money but merit badges. The merit badges of publication have now been utterly changed.

[27] In a letter sent to several fellow participants after the Roundtable, Lanham put forth his view that the presentation of information on an electronic screen is the latest manifestation of the age of *Secondary Orality* of which Marshall McLuhan wrote. Lanham: "McLuhan began life as a student of classical rhetoric and its manifestations in Elizabethan English literature. He then did graduate work under Father Walter Ong at St. Louis University. Ong was exploring the relation of print technology to Western culture. McLuhan added television to the mix [See Philip Marchand, *Marshall McLuhan: The Medium and the Messenger*]. McLuhan was the popularizer, Father Ong the philosopher of this crucial area of modern thought for computer studies, the distinction between oral and literate thought. [See Ong's *Orality and Literacy* and his two collections of essays: *Rhetoric, Romance, and Technology: Studies in the Interaction of Expression and Culture*, and *Interfaces of the Word: Studies in the Evolution of Consciousness and Culture*.] When McLuhan left Washington University, he went to the University of Toronto. There he met the other profound intelligence which has thought about literacy and orality in Western culture, the classicist Eric Havelock. Havelock spent his life studying the period in ancient Greece when orality was giving way to a written culture. He was, it turned out, studying the period we are now living through — going from print to secondary orality — only in a reverse image. As a result, he is often writing about electronic culture when he seems 2500 years away, talking for example about the early Greek alphabet. [See *The Liberal Temper in Greek Politics* and the Havelock essays collected in *The Literate Revolution in Greece and its Cultural Consequences*.] The best discussion of what it felt like to live inside an oral culture is contained in Havelock's book about why Plato hated poetry: *A Preface to Plato*. It reads like a mystery book. Another unexplored area is the relationship of electronic text to ethical and religious values. In the mid-sixties, [Ong] gave the famous Terry Lectures at Yale, on religion in the light of science and philosophy . . . later published as *The Presence of the Word*. He talks directly about electronic technology at one point ("Electronics and the Sensorium Today") but the whole book is relevant to the deep ethical problems posed by electronic media."

(Lanham)

Second, how do we accommodate what's already surfaced over and over in this conference — the radical change in the icon/alphabet ratio of information? It's a change that traces back to print, but more clearly to the growth of literacy in Greece in the Sixth Century B.C. Accommodating this change is very difficult to do in a university. Academics call it "comic book culture."

Third, what do we do about the digital convertibility of the arts? Images, sounds, and words have now reached the kind of mathematical interchangeability for which Plato pined. This should change the whole structure of the university and the departmental structure built upon it. It should certainly change how the arts are taught, a problem Robert Winter and I are tackling in a new course we propose to introduce at UCLA. How do we handle it?

Fourth, what does the university do about the radical desubstantiation of education taking place? We still act as if we are in the Middle Ages, renting out seats in a lecture hall for students to take down the gospel.

Fifth, what do we do about access to the university? People are saying that multimedia requires expensive pieces of equipment unavailable to disadvantaged groups. The real issue isn't that at all. The real issue is, how do we move information around in the sensorium from one sense to another, so that people who don't do well with words can succeed with images or sounds? There are a great many cultural prejudices against this, but it is at the center of any solution to the problem of access.

Sixth, what do we do about libraries? A fundamental change is occurring in libraries themselves — a change from curatorship to interpretation, to recreating attention structures.[28] The whole relationship of libraries to teaching is

[28] The scholars and specialists appointed as heads of major university libraries in recent years tend to impose their own values on collections. Archival work, once primarily curatorial, has changed to becoming interpretive as these disciplinary specialists decide what should and should not be preserved.

almost uncharted ground. Electronic text could be genuinely enzymatic in bringing study and discussion to this neglected subject.

Seventh, what do we do about accounting for costs in the university? It's no secret to anybody except perhaps the university that it is going to have to adopt a much more precise accounting procedure than the one employed today. The temptation is to use electronic text the way General Motors used robotics — as a kind of mindless solution. General Motors ended up with a reduced market share — from 50 to 30 percent. I fear the university may indulge in a similar type of bottom-line thinking.

Let me offer three concluding generalizations. First, John Sculley said this is an unprecedented world and we don't understand it. I beg to differ with so important a voice in the computer world, but we do understand it. The aesthetics of multimedia text, as George Coates made clear, is perfectly understood. It has been explored by the visual arts since the beginning of Italian futurism, dada, and surrealism early in the century. The whole post-modern aesthetic in the arts is the aesthetic of electronic text. I've been arguing that the personal computer is not a logic machine, but the final post-modern work of art. We have the equipment to understand this world, if we would only use it.

Second, universities will not be able to operate very long in an expressive medium that differs from that of society at-large.

Finally, these theoretical questions which I've just begun to pose and which the arts take up in great depth have immediate implications for the university. They affect, for example, considerations of cost, space, core curriculum, access to information, and the hypertrophy of academic publication. It's essential that we explore these issues. Where in the university should this conversation take place?

(Lanham)
It's almost as if the compartmentalized university were designed to obstruct such a conversation. Either we will have to invent a new place for it, which I think is not unlikely, or we will use one that already exists. I would suggest three possibilities: (1) the Library; (2) the Writing or Literacy Program, like the one I started at UCLA; or (3) the Business School. There are very different rationales for each alternative. But we have to start the conversation somewhere. I hope one of the action programs emerging from this meeting will be to suggest the *wheres* and the *hows*.

■ Luskin

In my seven minutes, I will address two critical obstacles to the success of multimedia software in the consumer and education environments. The first obstacle relates to the problem of design. The second is the need for a standard digital format that enables all optical disc software to work on any player that is small, easy to use, inexpensive, and fast. The need is for a common format that enables greater diversity and ubiquity of access by large numbers of users.

Hardware technology is no longer an obstacle. We know how to fabricate discs, and a variety of platforms and tools now provide production pathways for emerging integrated multimedia titles. Software is now the issue. How does one *design* an interactive disc? What is its *look and feel?* What are the conventions and standards of software design archetypes (as opposed to platform coding architecture and approaches)?

Software design has been taken too lightly in the past, simply reflecting the struggle to organize and present database materials interactively. With the coming of multimedia, interactive software design must become more oriented to the needs and wishes of the user. It is a non-trivial activity that requires a high level of skill, especially if the product is going to be easy and pleasant to use. Most existing products are not. Much of the work on navigation interfaces in past decades is Byzantine.

As we approach the 21st century, and as companies begin spending hundreds of millions of dollars developing interactive software, issues of look and feel, and of art direction rocket into importance. We need to pay more attention to these issues to understand them better. The design of interactive software is really a cognitive science. Since all interactive software uses a stimulus-response model, it should be based on sound principles of cognitive psychology. Presently, it is not.

At AIM, in association with the producers of CD-I, we are striving for a new look and feel, intuitive navigation, and novel approaches to the user interface. On the visual side, we are planning multiple planes, claymation, advanced iconography, and new types of fonts that will create a look that is semiotically different and better than ever before.[29] We are also working on new audio techniques, including punched-up narration that is not boring, and voice and music that are dynamic and of CD quality.

It is difficult to interweave media elements effectively. This will be the job of people coming together to form a new industry from film, print publishing, audio, and computer software. The scenes and screens in pre-production will derive from the cognitive mapping techniques used. In fact, the charting and pre-production layout of interactive work is really a form of cognitive mapping, designed to blueprint the media elements so that a person may interface with them in a stimulus-response environment. The challenge is to make software responsive to the user, both tacitly and experientially, while creating the experiences of learning and pleasure. The necessary elements need to be infused into software of the future, just as techniques of computer programming and database manipulation were critical to the software of the 1980s.

[29] Luskin is referring to AIM's plans for a new type of user interface created by an innovative integration of visual elements on the screen.

(Luskin)

The second obstacle to the success of multimedia software in the consumer and education markets emanates from the debate on open versus common architecture in the context of optical discs. Open architecture for me is the *sticky paper* of communications technology. I mean, you can't get there from here.

As a former college president of one of the most heavily campus-oriented technology environments for learning in America, I speak with the conviction of experience and the scars of a victimized user. Without inexpensive, easy, fast, low-maintenance players — with carefully created software which people love to use — interactive technology for the consumer and education markets will continue to stagger. People will not use complicated environments that require a high degree of maintenance or otherwise interfere with their enjoyment of content. Optical technology can succeed on a large scale only if all discs play on all players, software stops become obsolete, and the environment is forward-upgradeable and backwards-compatible, providing confidence and comfort to users.

Consider the standardization of the typewriter keyboard and the ultimate dominance of the VHS format for VCRs. Also, consider the establishment of the audio standard for compact disc, which helped make CD-Audio one of the fastest developing and ubiquitous consumer and educational technologies in history. So must it be with multimedia extensions of CD-Audio.

We urge acceptance of the principles underpinning CD-I. They are sound in concept.

■ Catterall

I am a professor of education at UCLA who has been dealing with the problem of school drop-outs for the last few years. The figure cited earlier by Bob Abel on the cost of the drop-out phenomenon came from a paper of mine a few years ago. It seems to be motivating to businessmen.

One focus of my work has been educational change. Over the years, technological innovations in various forms have been aimed at schools with less than impressive results. Radio, television and PCs all have histories of lofty promises, low levels of adoption, and even lower levels of use. But two technological revolutions have stuck. One was the unbolting of school desks starting in the late 1930s. As John Sculley said, it took about fifteen years for that idea to fully revolutionize the way classrooms were physically laid out.

The other was the textbook. The textbook is user-paced, easy to flip back and forth to check or re-check on something, usable with large or small groups, and portable. You can use it on a bus; you can use it while you're waiting for something to happen. Textbooks were the other revolution that stuck.

I sense an assumption in this group that one of the reasons that computer-assisted instruction and computers in education generally have not worked is that the technology has not been up to whatever it was that was being attempted. This implies that a better, more friendly, useful, engaging technology will break through resistance to adoption and utilization. That is a proposition worth testing, and likely to be tested.

I don't want to be pessimistic, just realistic. Previous technologies in the schools, to my way of thinking, have suffered from a case of *supply push* not being met by a *demand pull*. I don't have the statistics, but my guess is that the lion's share of personal computing hardware in the schools today is there because suppliers have put it there, not because users have demanded it be there. It's no wonder that these computers are sometimes left aside or put in closets.

What is the potential demand for computers in schools, and what might drive a school's interest in technology? The incentive is not likely to be the burning desire to improve. The examples of the lack of interest of schools to improve themselves are legendary. And yet, demands for change do exist.

(Catterall)

The standardized high-stakes testing industry, for example, is moving away from measuring the recall of simple facts toward really being able to assess the performance capacities and problem-solving capabilities of children.[30] This is a massive movement undergirding the research and development efforts of the likes of McGraw-Hill. California's recently adopted curriculum frameworks are guiding curriculum development, not only in California, but across the nation — demanding that curricula be integrated, and that children learn to write and think. If technology can help increase the level of success in meeting so mundane a goal as having kids score well on a test that's published in the newspaper once a year, that is going to result in a *demand pull* for technology.[31]

I'm working on a project that's attempting to integrate social sciences and language arts for elementary school children who have low prospects in life as well as school.[32] I see rich possibilities in this project for the media being discussed here. What better way to think about metaphors for expression and multiple representations of ideas than to see these representations visually in the classroom, rather than hear streams of words emanating from a teacher's mouth.

We need to get to kids early, before MTV is hardened in their arteries. Employers are crying out because 10,000 applicants show up for a basic-level job and only 800 can pass the entry exam. Schools do a thousand things now, but for most kids, not many very well. As Robert Winter said, "We need home runs, not singles." Let's get together to work on one front in a unified

[30] Catterall explains: "High-stakes testing refers to tests such as the California Assessment Program and other statewide activities that test kids at three or four grade levels every year, and publish the test scores by school in the media. If schools march to any drummer, it's the idea that their test scores ought to be higher. When their scores drop, they look for ways to raise them. High-stakes testing tends to drive the efforts of schools with respect to what they teach. There is a great deal of it taking place."

[31] Most states conduct an annual testing program and publish test scores. Realtors are the first to clip the score tables, followed by school board members.

[32] The Arts in Learning Project, 1990-94, sponsored by the Galef Institute in Los Angeles.

way to meet a widespread but focused need in instruction, such as fractions in mathematics. If we do one thing well, word of mouth will do the rest.

Negroponte

Can I ask Mr. Luskin what he meant when he said "open architecture for me is the *sticky paper*?"

Luskin

One thing that has constricted the use of software in a multimedia environment is its inability to be shared among players and people. The only way I think software can succeed is if something like the typewriter keyboard and the standard for the CD-Audio disc, which became common formats used worldwide, are held to, so that everyone can easily play and interface with multimedia materials on simple equipment. The concept of open architecture frees developers to do whatever they want, but in the end, results in custom pieces of work that can only be operated in restricted environments.

That is the difference between *open* and *common architectures*. The consumer electronics companies that have been successful in the consumer and education markets have succeeded by devising ways for all can openers to open all cans. Common formats that are ubiquitous and infinitely compatible, and don't go out-of-date, offer an opportunity for common architecture. Unique characteristics like full-motion video chips, great though they may be, lead to the development of custom material useful only in a restricted environment.

Stulberg

Bernie and I are partners in an enterprise known in the consumer electronics environment as American Interactive Media. The question just asked and responded to goes to the heart of what we're about in multimedia. So long as the approach taken is based on the historical perspective of computers, it's going to fail. Protected software is like patented razor blades. What works in this society is the transfer of information, emotions, and compelling

experiences through friendly materials played on the home television set and compact disc player.

Rather than making speeches seven minutes at a time, we should start throwing a few brickbats at each other and really talk about the multimedia experience. If we continue from the orthodoxy of a computer background, or of open architecture, we're not going to fix education or get anywhere. We need to look at what's happened in the consumer electronics area — the failure of VHS/Beta, for example, and the singular success of the compact disc worldwide. I'm glad Professor Negroponte raised the question and Bernie answered it. I hope we really get into some open confrontations on issues of this kind. They go to the root of what we need to discuss.

Luskin

The seminal point as it relates to the consumer and education environments is how Joe Bag-of-Doughnuts can get access to whatever materials he wants. Mike Multimedia's complex, shoot-'em-up system that uses six devices wired together may impress, but few can operate or afford it.

Chen

Bernie and Gordon, I think we get your point. Let's see how others are reacting.

Negroponte

Don't stop it when it's getting interesting! I completely agree with the VHS/Beta argument just presented. I'm certainly not advocating in any way that we should relive that experience. But both gentlemen have represented such an old-fashioned view of open architecture that it's mind-boggling. Open architecture achieves exactly what these gentlemen want. As we move more and more into the digital world, we don't need the kinds of standards we did in the analog domain. You said you wanted a *common* architecture; you implied a *closed* architecture, and *surely* you want it to be *your* architecture.

Luskin

Not necessarily. I just would like people to have access. Don't put words in my mouth.

Negroponte

That's why I said *surely*. The point is that an open architecture can accommodate CD-I. A contemporary open architecture is precisely what you want. Your company does not have to sell the world on CD-I, but on open architecture, so that a receiver can recognize what is being sent and cope with it. In modern digital thinking, the notion of standards completely changes flavor.

Stulberg

I think it's interesting that you make a statement in front of this group that we should not be selling the world on CD-I as the only architecture. It's important for this group to know that not only have we not done this, but conversely, we have faced your ridicule and continuing statement that CD-I is a failed technology. If you were to acknowledge publicly what you just said, that CD-I can be embraced within the family, we'd be absolutely delighted.

Negroponte

I have, many times.

Kay

What Nicholas is saying is incredibly important. I happened to sit in on a few meetings at Warner's in the old days about what the next CD standard should be. I was appalled at the suggestions for CD-I, precisely along the lines of what Nicholas is objecting to. It isn't the fact that CD-I was low resolution. It's that it was closed to all future technologies. It was a disc format. It did not have, like Postscript, an open, resolution-independent way of dealing with images.

We said at the time that the most important thing in defining the standard was to try to make it expandable for hardware that does not yet exist. I believe CD-I should be as Nicholas suggests — one of the standards recognizable by ever more powerful systems, and completely programmatic, like Postscript. It would then have a much better future — one that extends for more than two years or so.

Negroponte

My point is that open architecture is CD-I's best friend. Open architecture is how CD-I is going to make it. For you to argue against it is like shooting yourself in the foot. That's my point.

Luskin

I agree with you.

Negroponte

Fine, then why did you refer to open architecture as the *sticky paper*? That's what I asked you to clarify.

Luskin

My fundamental concern is that the architecture be *common* enough for all software to be able to play on all players. Unless we can do in the home and school what the compact disc has done, there's no chance for mass access to software.

Seybold

I'd like to turn CD-I off and get back to what Alan Kay said about technology not helping much in education. I think many people assume that technology *can* help, if used to make the classroom more interactive. Even better, it can help by simulating concepts so students can learn from experience rather than having to be told. Were you saying that you don't believe this?

Kay

I once gave a talk about a great old technology called Basic Organization Of Knowledge — BOOK. I included McLuhan's observation that an education at Oxford in 1190 consisted of thirty people in a room taking notes from somebody talking. The printing press changed society and everything else. Yet schools in North America still have thirty people taking notes from somebody talking. That's exactly what we're doing here.

McLuhan claimed that though the book changed society, it did not change the mass of humanity. It was actually rejected by teachers. We complain about illiteracy. But you know, cops need criminals. Teachers really want to get up and tell students what they need to learn. England uses the book as an educational technology, but for the most part, we do not.

The point I was making is that we don't need a musical instrument to become musical. We can sing. True educational experiences are rooted in our "body knowledge" and social values. Some of the greatest libraries in the world are in the middle of Spanish Harlem and nobody goes inside. Why? Because they don't know that the knowledge in there is valuable. That's the number one problem. Seeing Bill Cosby go into a library on television is not going to help. What we need is for people to be more thoughtful, not simply recognize more situations.

Catterall

Let me add that the success of the textbook was, in part, due to its being able to adapt to long-standing conceptions about teaching and learning. That is, the textbook is very compatible with a teacher-centered classroom. I think we tend to think of computer and multimedia presentations as liberating, generating the capacity to individualize and bring true child-centeredness to education. While this can happen in schools without multimedia, it tends to be at the fringes and in the trenches. For the most part, teachers talk and kids take notes. A textbook is compatible with that.

How do you make better technology? Multimedia, in a sense, is a better book. How do you adapt it to the mores? How do you start a massive infusion of technology into schools, short of changing some long-standing conceptions of what schools are and do?

Dillon

I'd like to suggest that multimedia may be hostile to institutions of higher education. What makes a university like UCLA so valuable is first, its physical embodiment, and second, the people here. We come to this place to meet with these people. Interactive multimedia could take information from the institution and from the people there, and shift the information in time. This might change the function of the institution and reduce its value.

I would think that educators in the future might have two different roles to play. One would be as classroom facilitators, helping students use devices, and providing motivation and explanation. The second, for those who like research and enjoy organizing and presenting information, would be as interactive designers. It is their personae that would be on systems used in other places at other times.

Still, I don't see interactive multimedia flourishing in higher education, because it destroys some of the fundamental assumptions about what universities are.

Mayer

I want to ask Alan Kay about low-tech, high-touch media, such as paper and blocks. Have *they* been well-integrated into schools? Maybe there is a mismatch with the technology.

Kay

I think they have in many schools. What we must understand is that knowl-

edge is the same however presented. People believe that if they can present knowledge to students in the form of images, learning will be easier. In fact, all the evidence says the opposite. The way students learn is based partly on the form in which they take information in, and on how thoughtful they are about it.

I really don't care for technology, except I like to use it. We have to think much harder about content and the psychological makeup of the people receiving it. That's where we should start — whether we are building a computer interface or designing a new multimedia system. If we want the system to work and be successful, it has to have something to do with the way people actually think.

There's much more going on inside people than patterns of stimulus-response. We understand far more about learning than we apply in design. We went to Xerox PARC with what I thought was a really good psychological model.[33] I still feel this way twenty years later. Having started with the model, it astounds me that it took five years of hard effort to come up with something like the Macintosh user interface. We had to work with hundreds and hundreds of children and adults to achieve a synthesis of ideas. We now have some design principles, but we need more. The goal should not be just to make material entertaining, or enable students to recognize something when they see it again. It should be to help them become thoughtful. That's the challenge.

Bushnell

My feeling is that the efficiency we gain in giving more bandwidth to the student is the essence of what we're trying to achieve with multimedia. But, we can't solve the education crisis. To put a syllabus together for elementary schools in America with production values equivalent to those of television

[33] Kay is referring to Jerome Bruner's multiple mentality model of learning, presented in Bruner's *Towards a Theory of Instruction*, New York: W.W Norton. 1966.

shows and commercials would cost $1.5 trillion. The $5,000 per student per year we pay on average does not go very far.

Belove

Robert Abel's *Ulysses* and Robert Winter's *Ninth Symphony of Beethoven* are wonderful, but they're television — nonlinear television. Pushing buttons and bringing up windows on a screen is not *interactivity*. To me, *interactivity* was the interchange that occurred between Luskin and Negroponte. It's important that education encourage this kind of interactivity. I hope we are teaching people, at least at the higher levels, to think critically and analyze. I'm not sure being more efficient or using more bandwidth to push data across the screen is going to accomplish this.

Catterall

I think you're suggesting that these technologies, at their very best, have to fit within a system that demands performance and expression outside of the immediate computer environment. Is the technology a vehicle for creating people who can think? If so, do the people show their ability to think by pushing the right buttons, or by interacting with other human beings in more effective ways?

Belove

That's exactly it. Twenty years ago, the introduction of teaching machines into the classroom to replace teachers was a dismal failure. The failure was not for lack of technology. I think we run that same risk today.

Abel

I happen to agree with what you are saying. We built an alpha version of *Ulysses* in order to create something. The next step will be to get the kids' ideas up on the screen. They'll be adding their own thoughts. We are halfway there in being able to do that.

Winter

One of the points I make when I demonstrate *Beethoven's Ninth* is that if you were to get the same material in book form and you don't agree with what I say, you're stuck. But with the HyperCard architecture, the *Beethoven* is totally open. You can alter any of the text yourself.

Nevertheless, I agree with Bob Abel that we are not at the level of interactivity we want. I prefer to demonstrate *Beethoven's Ninth*, by the way, with a grand piano on which I can play the music.

Kay

That's a very good point. It shows *you* can do things with your system that go well beyond what's actually packaged. It's like Seymour Papert. He can do almost anything with *LOGO*. The problem is they never found a way of stuffing Seymour into the *LOGO* program.[34]

[34] See *Mindstorms* for a discussion of *LOGO* and the ideas of Seymour Papert (See Bibliography).

Rob Glaser, Moderator
Nolan Bushnell
Robert Stein

The prospects for interactive multimedia in the home are bedeviled by uncertainty. Only one thing seems clear. Multimedia is not likely to take hold quickly or according to plan. If it does not take hold, it will be the latest among the many highly touted systems for computing in the home that have failed to live up to expectations. Moderator Rob Glaser recounts these forebears and lists some of the reasons for skepticism, before assuring the group that his company does believe a home market for multimedia will develop, and is investing to make it happen. Nolan Bushnell stresses the importance of having prices the consumer can afford, while recognizing the potentially exorbitant costs of production and the pressing need to empower small producers. Bob Stein gives a restrained assessment of the current state of new media works, indicating what he believes is required to achieve more high-quality productions in the future. The most optimistic outlook is presented by Gordon Stulberg, as his well-financed company gets ready to inaugurate products it has been working on for the home consumer market. A high point of the session is Robert Winter's narrative on his efforts to design a multimedia house for his family and himself. The session concludes with a lively discussion about telecommunications, a field whose future may be closely tied with that of multimedia in the home.

■ Glaser

I could give many reasons why interactive multimedia will not happen in the home. One argument is that there is no real consumer interest. Let me cite some examples bearing out such a conclusion.

The first example is consumer videotex, which has some resemblance to interactive multimedia. *Viewtron* and *Gateway* were two of the better known systems. Both were aggressively marketed. Serious efforts were made to find attractive applications for consumers. Both are now defunct. There are many other skeletons along the trail. *Prodigy*, with deeper pockets, could break the string, but it is still too early to know. The French *Minitel* service is reported to be successful, but it had the benefit of government sponsorship and largesse, and with the possible exception of telephone directory services, text-based dial-a-porn may today be its most popular use.

A second example is the interactive videodisc experience. Several people at this conference are refugees from that business. You could do a postmortem apologia for why the market didn't materialize. There were no standards and there was customer confusion. People thought the videodisc player was a VCR that did not record, so why buy it? But the fact remains, the market didn't happen. This could bode ill for multimedia in the home.

Third is the example of home computers. The first personal computers were hobby-oriented. The original Atari computers were consumer systems. The first Apple computer sold for $666.66. Hobbyist kits, designed as consumer products, were in a similar price range. In going through the attic two weeks ago, I came across an Apple II brochure from 1977. It showed the picture of the mythical mom with her recipes on the computer. Remember? Visions of computers in the home are hardly new. The experience gives little basis to feel encouraged about multimedia in the home.

Another impediment to multimedia catching on in the home is the absence of obvious or simple standards. Multimedia seems too expensive for broad

consumer use in any reasonable time frame. The average selling price for personal computers has gone up probably by a factor of two since their introduction a dozen years ago. In the business market, the price of configured systems has coalesced in the $3,000 to $5,000 range. If that's the price/performance point computer manufacturers are focused on, there's no reason to believe they will be leading us towards a consumer market.

Last but not least, there are very few titles. I asked Bob Stein last night what multimedia products other than his own (Voyager's) he thought were really good. He couldn't think of any. That's pretty frightening. Are we talking about a new medium for which there are no credible examples, other than perhaps *Beethoven's Ninth?* That's a daunting thought.

Well, we didn't come here to talk about why a market for multimedia in the home is not going to materialize. I'll now tell you why Microsoft is investing about $10 million a year to help develop this market, and why we believe it really will happen.

In spite of my comments about no potential consumer interest, there clearly is a vast need to do something better with our discretionary time. The 25 hours a week that kids spend watching television is an activity by default. Parents have not said, "Here is the set of things I want you to learn in the 25 hours you watch television." It happens in a vacuum. This provides a firm basis for an interest in multimedia. We have time available. We should turn our energy and creativity to the task of taking advantage of this time so that we do not become a nation of video idiots.

People do want to learn when properly motivated, and they do want to experience that learning interactively. Admittedly, this may be more an assumption than an empirical finding. I'm not an educator. But my own educational experience has told me there is something here to tap into.

(Glaser)

As for standards, they are appearing without anybody's doing anything about it. There are two or three different standards. (We can discuss later which of these standards are truly open, which are sort of open, and which are not quite open enough.) In addition to the CD-I work that's been discussed, the most fundamental standard in the home has developed by default. It's the PC itself. There are about 45 million DOS-based PCs and several million Macintosh computers installed around the world. The run rate for the DOS PCs is about 10 million systems a year, of which probably 1.5 million are purchased explicitly for use in the home, many by people who work there part or all of the time. Half of all PCs costing more than $500 sold for home use are DOS-based machines.

Thus, without anybody trying very hard, an increasingly powerful hardware base has developed in households. The average machine sold to a household at this point runs an Intel 286 processor. Probably half of these machines, according to research Prodigy has done, have a VGA display providing a very nice color image and good color text. If we are clever, we should be able to upgrade this ready-made hardware base fairly inexpensively and begin delivering the multimedia experience to consumers at home.

Finally, even though it may be difficult at this stage to think of titles that effectively express the vision of multimedia, I feel from the discussion we've had here that a number of content people are doing great things to make the multimedia market a reality. From my perspective within a systems software group at Microsoft, I believe the best thing such people can do is ship product. This is not to say the market is well understood, or that the tools to build these products are fully developed and available. But there is no substitute for user feedback. The only way we're going to get this feedback outside of demonstrations like Robert Abel's *Ulysses* is to create works that people can buy, fool with themselves, and report back to us about. This means shipping product.

Negroponte

You seem to have made an enormous oversight. There is an example of multimedia in the home that has thousands of successful titles.

Glaser

Nintendo.

Negroponte

Yes. You can't dismiss it. I thought you had forgotten about it.[35]

■ Bushnell

I always feel on the vulgar side of multimedia because of my desire to make devices that are cheap, easy to use, and workable today. I have a cynical view of the price point necessary to achieve meaningful penetration of the home market — under $300. Thousand-dollar multimedia machines may be acceptable for *needs-driven* people willing to make an investment: people who have incomes over $40,000, discretionary money to play with, relatively high levels of education, and some greater purpose to serve, like altruism.[36] But for the average *wants-driven* consumer, the price must be more like $299, $199, or $99 — retail![37] Then we can start selling boxes.

Multimedia has a very significant problem. Since it is a superset of all other media, production values for content are potentially very large. Production

[35] Nintendo is a Japanese maker of computer games whose machines have penetrated one in five American homes, giving the company an 80 percent share of the U.S. computer-game market. A month-and-a-half after the Roundtable, Nintendo announced it was contributing $3 million over five years to the MIT Media Lab to support studies of how children learn while at play. The games have come under attack from some parents, who complain their children are addicted to them to the detriment of learning.

[36] Profile of the "needs-driven" household: income over $40,000; college graduate; less than 55 years old; areas of perceived need include education, communications, "agented" information, financial transactions, shopping, and investing; potential size of market,16 million.

[37] Profile of the average "wants-driven" customer: income about $15,000; high-school education; all ages; areas of interest include entertainment, gaming, hobby, games, and sports; potential size of market, 144 million.

(Bushnell)

of a feature length movie costs ten million dollars an hour plus. Television of broadcast quality costs about a million dollars an hour plus. Production costs for equivalent values in other media areas are also huge. To bring the quality of multimedia up to the level of the media it incorporates is going to cost a lot of money. It's a very sticky wicket.

How do we solve the problem? We solve it through authoring systems. I believe the only way multimedia is going to be successful is by guerrilla warfare in the garages with authoring systems. It will have to be possible to purchase these systems for under $25,000 to enable relatively good production values to be provided inexpensively.

There is currently a test of multimedia taking place both in Canada and the United States: a test of the ACTV model. ACTV has the advantage of costing under $20 a home per subscriber; its disadvantage is that it takes a great deal of bandwidth. An even bigger problem is the 100 to 200 hours of software that was built for it. There was a lot of money spent (including some of mine). The software is dreadful. It's great technology, and it's cheap. But the software is horrendous — difficult and very problematic.

We know that the two forms of content that have worked well with past technologies are storytelling (done forever) and game playing. But the notion of interactivity violates a cardinal principle of storytelling. When people are allowed to mess around with the characters and story line, it undermines their ability to have fantasies and to escape, and their willingness to believe. Tests done in the interactive story mode are not reliable.

But put a person in the role of a gladiator, explorer, or other active participant in a game with a high degree of interest and broad bandwidth. Then multimedia has a chance.

Education can help too. It is one of the areas that brings technology into the home. But for multimedia to get a foothold in education, it must be much more cost-effective than it is at present.

Finally, I believe we have to define our systems carefully. Because of the extremely high cost of media production, I don't think systems that rely on software sales alone can succeed. The software must be able to attract streams of advertising, broadcast, cable, and rental revenue, as well as sales. Anything interactive that has to be at the user's location or file-served is likely to be too expensive to gain more than a small following. It will probably not be a winner long-term. A video game produced by a few people for under half a million dollars, and priced accordingly, might be an exception.

I have been a backer of Stewart Brand's phrase *broadcatching*. I like it a great deal. High bandwidth broadcatching systems that allow for advertising and broadcasting revenue streams may be able to justify the tremendous cost of authored material. Overall, I believe interactive multimedia in the home will happen, but it will happen primarily through game playing and when prices fall below $300. It will be a very difficult row to hoe until we get to those price points.

■ Stein

I have a tremendous problem with the phrase *multimedia*. In six years at our company, we have only used it once in print, and that was accidental. It means so many different things. For most of us, *multimedia* usually describes a videodisc player and a sound source connected to a computer in some way. The problem is that under this description the games of Nintendo, and those of Atari before it, do very nicely as examples of multimedia. At the other end of the spectrum, so will text and literature when brought into a computational environment (an obsession now at our company). If *multimedia* can

(Stein)
mean all these things, then fine, but I'm more comfortable with a phrase like *new media*. It's more flexible.

Yes, I did say that I didn't like any actual product I've seen other than *Beethoven's Ninth*. (I was not addressing Nintendo.) In fact, *Beethoven's Ninth* is the only product of ours that I'm really satisfied with at the moment. That's because for me it's the first mature work authored on a computer. Robert Winter did not send us a manuscript to translate into computerese. He wrote his work in the computer environment.

I will make four quick points about what I think is needed to have more high quality new media products. First is the authoring environment. *Beethoven's Ninth*, so far as I can tell, could run perfectly well on platforms such as those of NEC or SEGA. The reason there is not more intellectual work being done for these platforms is that they lack a suitable authoring environment. Even for CD-I, it's very difficult to write programs unless you are a programmer. The goal should be to make it possible for writers like Robert Winter and Dick Lanham to communicate with new media without having to learn arcane computer language. HyperCard on the Macintosh makes this possible. It was a tremendously important development.

Second, on the hardware side, I agree with Nicholas Negroponte that videodiscs may disappear in the future, but not until there is something digital with which to replace them. This could take five or six years. In the meantime, it would be wonderful for manufacturers to put RS-232 interfaces on the back of their CD and videodisc players, allowing us to bring the technology into the home. The products our company makes for the home market are now bought by schools, not homes, since school players have the RS-232 interfaces and home players do not.

Third is content. Content resides in two places: in the heads of people like Robert Winter, and in the incredible body of Eastern and Western culture

produced over the last several thousand years. The single biggest barrier to good products in multimedia is the outdated copyright law, discussed in another session. Suffice it to say that we desperately need an automatic mechanism in multimedia comparable to the ASCAP/BMI system for music, so that I could take something from *Gone With the Wind*, put it on disc, and know that if I sell 10,000 copies I must send MGM so many dollars. The reason such deals cannot be made today is because of the high legal fees and the lack of understanding of what this material is worth in the new environment.

Last is the question of retail sales. I, for one, am not going to fork out $50 to $100 for something in the Nintendo or computer software store about which I know little. Book stores work well because you can take the book off the shelf, open it, browse through it, read the first paragraph, read the last paragraph, look at the pictures, and then decide if you want to buy it. Record stores work because you can listen to the music on the radio. The records are pre-sold that way. Video stores work because of theatrical advertising.

We desperately need a technology for browsing the new media. It's a good bet for venture capitalists, who could make a lot of money providing a future retail environment for solving this problem. But please don't come back with the idea of browsing at home via fiber optics. I wouldn't mind, except that I love to shop in stores. I don't want to lose that experience.

Arnett

I have one question for Nolan Bushnell and one for Rob Glaser. Nolan talked about the cost of production values. I think the more personalized the information, the less production values are important. I don't care much if a video image of my new niece is out of focus, blurry, or shaky. For content with so much personal meaning, we don't pay a great deal of attention to production values. We may become easier to please with more intimate computers.

The second question, which is in some way related to the first (I didn't plan this), has to do with the popularity of dial-a-porn in Minitel. Is there any reason to suppose that this won't happen in multimedia?

Bushnell

Production values here in Hollywood are crazy. If we can keep the attorneys and unions away from multimedia, the new technology should be able to achieve equivalent production values for a fraction of the cost. We will not be able to do that entirely, but there's a potential. That's why the key is empowering the editor working in a garage with the kinds of tools necessary to give good production values. There's not necessarily a 100 percent correlation between production values and cost. Efficiencies are possible, even though words like *efficiency*, *cheap*, or *inexpensive* are often equated to *bad*, *improper*, or *not worthwhile*. We can sometimes have it both ways.

Glaser

Nick Arnett's second question alludes to the role prurient material might play in developing the home market for multimedia. Conventional wisdom says the availability of "adult material" not commonly available in other media was a major factor in getting the VCR market moving. The use of such material has already started in multimedia. At the last CD-ROM conference, an Italian company wanted to include in the conference brochure an announcement of its illustrated history of pornography from 19th century daguerreotypes to the present. I believe the request was turned down.

Seybold

I want to second Nolan Bushnell's vote for empowering people with tools. I have some very good examples of how well it works in the music area. My next door neighbor is a very successful composer of movie scores. I've helped him set up his apparatus. Everything he does he now does with his Macintosh at home. Also, a young man who used to work for us had been trying to record for a number of years. He finally got a contract. They paid

him $30,000 for studio time. He did it at home and the record's now a hit. These are people who have used the technology themselves to produce their work in home studios.

Glaser

John Sculley enumerated four categories of multimedia application: productivity, information, education, and entertainment. I would suggest a fifth category: home or personal creativity. Music, video editing, and the like are examples. I think there's clearly a market in this area, even though it raises complex issues of technology integration.

Minsker

I started out agreeing with the panelists, then found myself feeling a bit misled. Let me make a few quick quibbles.

First, authoring systems don't shoot film or video, light stages, hire talent, write scripts, or design interactive programs. People do. Even if you can get a very inexpensive and easy-to-use authoring system, you still need to design the program, get the talent, and make something that is, in fact, the rough equivalent of what you see in the movies. There's no way to do that with technology. It takes people and creativeness — work that's hard and expensive.

With regard to disappearance of the videodisc, if you mean interactive videodisc in the home, I agree. It never really got started. But last year was the biggest for videodisc home movies ever, and the previous year was the next biggest. More videodiscs are being sold in the home today than ever. This is happening because Hollywood has discovered it can sell movies to consumers. Once consumers get in the habit of buying movies, they want the best they can get. Videodisc movies offer better sound and picture quality.

If *interactive* does ever make it into the home, we will not need a technology

for browsing, but for previewing. The reason records and movies sell so well in other formats is because we hear the music on the radio (as Bob said) and we see the movies. That's not browsing. It's previewing.

By the way, the book business really *doesn't* work. There are very few successful trade books. It's an awful business. Meanwhile, home video movies have become the biggest intellectual property business ever. They grossed over $11 billion at the retail level in the last twelve months, and will probably gross $12.5 billion this year. We love movies.

We need a previewing system to inform us about the interactive product we're thinking of buying. I can't imagine what this system would be.

Bushnell

Coin-operated games.

Kay

Bob Stein and I used to fly up to Atari from Los Angeles together and talk about music. I remember we spent time trying to learn how a Bach fugue worked. Much of what was successful in those conversations having to do with form is similar to what Robert Winter did on the Beethoven disc. The difficult thing we never got to — and it doesn't exist on the Beethoven disc either — is the vertical content in music.

Western music is the major inventor of what we call harmony. Harmony is not that hard to learn. You cannot learn it in five minutes, but you can easily learn what you need to know in about two weeks. It's not as hard as learning tennis, but it isn't an instant experience either.

I used to say the Macintosh was the first *personal computer* good enough to be criticized. In the same way, I would say the Beethoven disc is the first *new media work* good enough to be criticized. My main criticism is that it leaves

out what I think is the hallmark of Western art. Western art tries to start with emotion and amplify it through technique. None of the other arts around the world has tried to merge the two sides of humanity as much as Western art, particularly in its music. Users of the Beethoven disc do not get that insight. They may think they have learned more about *Beethoven's Ninth* than they actually have. What they've learned is how to walk through the symphony. They haven't learned why it works.

This content problem is one of the major items we need to work on. It's like people thinking, after seeing Carl Sagan on PBS, that they've learned something about astrophysics. In fact, all they've learned is the kind of barber Carl Sagan has. The lucky ones are those who go out and buy Carl Sagan's book. Then they may learn something about astrophysics, but not from the television program.

I would like to ask Bob Stein to comment on what he plans to do about subjects that are two-week rather than five-minute learning experiences.

Stein

For me, *Beethoven* is more like a ten-minute than a five-minute experience, but it is probably not a two-week experience. Nevertheless, there are things missing from the disc.

I actually disagree with my author's response to the question on interactivity raised at the end of the session on education. I don't think the point of making the disc interactive would be to let the student write his own notes or add his own comments. That would make for a growing book, but not an interactive one. What's missing from the *Beethoven* disc for me, and from many other programs we call interactive, is two levels of dialogue. On the first level, users should be able to literally query the material. If they are reading a paragraph and don't quite get it, good interactive material will someday be able to answer their questions 95 percent of the time.

The second level relates even more closely to the *Beethoven* disc. In trying to understand the structure of music, I need to be able to manipulate it. If I'm told the music is playing at a certain tempo, and that's where some of the effect is coming from, I want to be able to change the tempo and hear what it would then sound like. I'm not sure everyone needs to learn this way, but I know I do. I need to be able to play with the music like a piece of clay. Only then do I start to understand it.

This should be possible given today's technologies. We didn't try to bite it off at this point, because we thought it was more than we could successfully chew, especially without a MIDI facility. But we plan to build such features into our next disc, Stravinsky's *The Rite of Spring*.

I have no apologies for what we did. One of the problems about being a publisher, as opposed to an R&D outfit, is that to survive from day-to-day, it's important to hit home runs. We were fortunate to figure out the minimal level required to make the *Beethoven* disc good enough to be criticized.

One of the biggest problems we have in doing things like this is that we don't get many criticisms. People seem to like our products so much that it's hard to get them to say what's wrong. We need journals or conferences, not focused on marketing, but on critical analysis of the content and design of programs. We have enough approval. What we need is more disagreement and questioning about what the interactive material is accomplishing.

Winter

I want to say three things. First, it's typical of the way we compartmentalize that one session of the Roundtable is devoted to education and another to the home consumer market. Perhaps there's no way to avoid it. But what appeals to me about the new media is that I can ignore these distinctions. In the same program, I can write for the guy who sells life insurance as well as for my sophomore undergraduates, because each can choose his or her own

level. That's what stokes my creative fires. I hear Bob Stein talking about showing his programs to a whole cross-section of people. We do not buy into the shopworn categories, "K-6, junior high, Midwest, or West Coast." We can now aim at a much broader target.

Second, I have not heard anybody talk about what I consider to be the biggest stumbling block to the home consumer market. I came up against the problem in a very direct way in planning to remodel my house. The ostensible grounds for starting the renovation was the fact that my 3-year-old daughter, who sleeps in the living room, had discovered that having the largest room in the house is not as big a deal as having her own bedroom.

I started thinking about how I would reshape my house into a multimedia environment. I began in my imagination by taking out the wall between my study and the living room so that I could have the hi-fi system and computer in the same space. Then I had to knock down the wall between the family room and the study to have the television in the same place with the computer and sound system. My house now had become a big imaginary barn with a video screen at the end of it, and a small suite of bedrooms in the back. Three weeks ago I sold the house.

Negroponte
Is this a Polish joke?

Winter
No.

Negroponte
I mean, could it be easier to move the TV set than take down the wall?

Winter
Of course I could move the television, but it would not really solve the

problem. Los Angeles is an architecturally maverick city, but ninety percent of the homes here are still laid out the same way. The bedrooms are the same size, the living rooms are the same size, there is a little study off the living room, and a little family room. The rooms are all set up with a lot of concrete, bricks and mortar, and steel posts to prevent people from integrating their activities.

So, we are designing a multimedia home from scratch. I've spent the last two months thinking about the implications of interactivity for living space, and about how our family of four will use this space. Do I simply put a terminal in the kitchen so that my wife and I can read recipes off the screen? It has to be much more than that.

Third, I want to respond briefly to Alan Kay's criticism. Hallelujah! Alan, you're the first person to stand up and say that we need to do more work. We agree. I hope you and I can talk more about it. But I think you missed a lot of what's in the program. There's considerable emotional content and plentiful discussion of the *whys*. My use of terms like *Defiance Theme* and *Joy Theme* would cause some of my hardcore musicological colleagues to say, "Good grief, what would Heinrich Schenker, the guru of modern analysis, think of these subjective indulgences?" To receive constructive criticism from both sides of the analytical/humanist spectrum tells me we're doing something right. We still have much to do.

Kay

I believe the invention of harmony came about because our civilization was the first to build a keyboard with which you could look at pitch, rather than just hear it. You basically cannot understand harmony from inside a choir. You have to be able to stand back, look, and think about it. The visual medium is the next step. We have to find a visual way of showing people what's going on, so they can see the parallelisms.

Winter

I asked our programmers to do many difficult things, such as enable people who had never had a music lesson to follow music notation in real time. Finally, they told me, "Look, if you want Beethoven to ship, that's all you're going to get on this one." That's why there's not a comprehensive treatment of harmony on the program. For Stravinsky's *The Rite of Spring*, we've hired live musicians, I'm playing the piano and talking, we've licensed the music, and we're doing more of what I think you want to see. As goals, your points are well taken.

Mayer

Picking up on Nicholas Negroponte's question, why not consider the Atari and Nintendo games as the first generation of multimedia? They provide a model of economic success, and also, case studies of failures — multimedia in the closet, things that didn't work.

Glaser

We do have some ex-Atari people here, and some refugees from the home computer market, but no one from Nintendo. Nintendo has done such a fantastic job of implementing what we already knew how to do ten years ago, it's easy to dismiss it. The company has perfected the tried and true, creating a product form that appeals strongly to male adolescents. By being very targeted, and smart about market management, Nintendo has built a multi-billion dollar company that seems durable, more than previous forms of the business. This base clearly can be built upon to provide something like what we call multimedia. If Nintendo has plans to do this, they have been very coy about telegraphing them. We would benefit from having a dialogue with Nintendo.

Stulberg

At the risk of having CD-I sound like the *be-all and end-all* of multimedia, I will address some of the issues just posed from the perspective of our four years of experience at AIM. For us, multimedia is now almost a reality in the

consumer market, and it will be in the educational market before long as well. First, Nolan Bushnell will be interested to know that the idea of a low-cost authoring environment was preeminent in our early work (with Mark Dillon and George Rebane). We have now introduced a complete authoring environment for using the Macintosh with an emulator and CD-I player for under $35,000. You don't need a studio to go right to the glass master.

Bushnell

Can you handle video in the studio?

Stulberg

Yes, and we will be having full-screen/full-motion video chips in the first consumer players by March 1991. We are now developing tools and titles for those chips.

On cost, we have been working to develop tools that would lead to a rapid reduction in cost. We should have a run-time engine available by Fall 1990. We anticipate that the average cost of a CD-I title — from the NASA disc to one teaching letters on *Sesame Street* — will be around $300,000. According to our business plan (which Philips requires us to do), this means we can be making money on a world-wide basis at under 40,000 discs, making for a very successful business even in the early stages of CD-I.

One other comment on cost. In 1982, Philips went to a convention to announce the CD. Jan Timmer, who will soon become chairman of the board of Philips, was then the head of Polygram. He proposed a compact disc player to be introduced at $1,000, when there were very good changers available at $300 to $400. He was literally booed off the stage. The pundits said no one would buy it. Well, they were right and they were wrong. In the early stages, the compact disc player went to classical music aficionados. Then, as its price came down to $700, $600, and $500, the customer base rose astronomically.

We are relatively satisfied about the market potential for CD-I from what we've seen of Nintendo and SEGA. We've done extensive studies. Philips will have put well over $200 million into CD-I, from development of the technology to the "razor blades" that we and other companies are producing. Philips does not enter lightly into a business of this kind, as evolutionary or revolutionary as it might be.

There is a palpable increase in the amount of money a consumer (not just the early adopter) is willing to pay for something perceived as a need. Our most recent studies indicate that the household buying into CD-I will be a 4-person family: father, mother, and two children somewhere between 8 and 14 years old. The family's average income will be between $60,000 and $90,000, which will tend to move up the purchase price.

Negroponte
Two comments. First, the number 40,000 is enormous. The number of book titles printed in quantities of greater than 40,000 is probably less than two percent. If 40,000 is your break-even point, I'd start selling short on Philips. That's a very high number.

Stulberg
Well, why don't you do that? I think it might be a good idea.

Negroponte
According to the book model, I don't think you can sell 40,000 titles unless you get into the Nintendo genre, where there are 20 million players in this country and the numbers skyrocket. I am shocked. I'm not trying to be critical.

Stulberg
Of course not.

Negroponte

My other comment is that it's absolutely mind-boggling that in a discussion on multimedia in the home no one would recognize that the real player in this market will be the telephone company. It might take Judge Green's demise or something equally dramatic, but eventually most multimedia will probably be done through the phone.

Abel

Nicholas is right on, as usual. The hidden player in all of this is the telecommunications company. My God, I've grown up on the phone. My kids have grown up on the phone. Look what we can get with twisted pairs right now. Can you imagine what fiber optics will make possible?

Bajarin

What SEGA is doing could be key for multimedia in the home. My kid calls up his friend and they play the SEGA game across town. There's no question in my mind that the Nintendos, SEGAs, and NECs of the world have every intention of being multimedia players in the home. They understand the component structures. Nintendo has made a deal with Fidelity Investments. By the end of the year, a modem and keyboard will be connected to the Nintendo computer to allow stocks to be purchased in the home, as is now done in Japan. These companies are very important forces. I would expect them to be the ones to get the process going.

Jones

Nicholas Negroponte suggested that Judge Green is blocking multimedia to the home in some way, but there's actually nothing legally restricting the carrying of multimedia information — images and sound — over the existing telephone network. The Bell operating companies cannot provide their own content, but they are certainly pleased to transmit information between content providers and subscribers. There is no restriction at all on the phone companies carrying video signals to your house today. There are plenty of content providers that could be sending information over telephone wires.

Negroponte
You're absolutely correct in what you say, but the incentive of the phone companies to put in the last mile of fiber optics, or bring T-1 into the home, is greatly reduced by the fact that they cannot use it for their own information. So, when Judge Green relaxes, what we'll see is an acceleration of the last mile of fiber and an even faster acceleration of T-1 into the home.

Lucky
There's nothing AT&T would like better than to put fiber into everyone's home. What goes in now is a drinking straw — copper wire.

I had a plot many years ago to bring interactive games into the home. People would interact with others around the country to re-create World War II from their own point of view. Such things can be done, and are very interesting, but they require a great deal of finesse to accomplish with the present 3 kilohertz bandwidth. The next step is ISDN, which will bring 64-kilobit channels into the home. With today's video compression technology, this would provide decent conference-call audio, moving video, and head-to-head video. But what we'd really like is optical fiber.

Current estimates by Bellcore indicate that in the year 2015 half the homes will be wired for fiber. This shows the mismatch between the rate at which multimedia and the telecommunications network are progressing. There are tremendous economic and political barriers to getting fiber into homes. The problem is that CATV is already there, and high-definition television could enter in other ways — from satellite, direct broadcast, cable TV, or video stores. The corresponding business interests are working hard to keep fiber out of the home.

Congress has the idea that all of us ought to have digital television, interactive services, pay-per-view video, narrowcasting, and all of the other good stuff. So, it would like to see fiber put into the home. One of its plans is to let the Telcos into the content business so they would have the incentive to

install fiber. But let me tell you, it's a tough play. I would not count on getting fiber into the home soon. It's going to take a revolution.

Kay

I don't disagree, but I think that's a bit of a red herring. A great deal can be done with existing telephone lines. Part of the problem is the local loop. The phone company is extremely unimaginative in the way it provides rate structures. What's needed is a contract on the amount of discontinuity a computer system wants from the local loop so that it can do burst-mode transmissions of packets. The powerful computers we have could buffer like mad if it did not cost so much to make the calls necessary to do buffering today. There's no need to tie up the lines when information is being buffered. We should be able to make a contract with the phone company saying, "We'll send the local loop a profile of our expected usage of the lines, and will pay more if we violate those guidelines, but if we stay within them, by God, give us a decent rate."

Lucky

As a technology bench mark, the local loop is capable of 1.5 megabits, full duplex. Modems have been developed to take advantage of this. But burst-mode transmissions and new types of contracts would mean changing the infrastructure of the whole telecommunications network. It's much better to hang things on the end of the line that do not require a change in the network, like voice answering and facsimile machines. The network evolves slowly. Equipment that does not affect it has the best chance of quick acceptance. This has been the formula for success in the past.

It has been said that television and other wideband broadcast communications should be in the fiber, or over a dedicated line, whereas computer communications and voice, being narrowband and point-to-point, should go through the air. What we have today is exactly the opposite.

Max Whitby, Moderator
Stewart Brand
William Dunn
Hans Peter Brondmo

The agenda for this session was kept open to accommodate issues of concern not included in the formal program or given enough attention in other sessions. We chose the title, "To Be Determined" (TBD). It adds some intrigue and, as moderator Max Whitby points out, nicely captures the unknowns characteristic of multimedia at the present time. A more conventional title would have been, "Designing for Multimedia," a subject Whitby had suggested. While the topics discussed in the session mostly reflect the interests of the moderator and panelists, they also express overall priorities of the group. Judging by number of words, the issues of greatest concern were: the problem of standards (first by a wide margin), the design of multimedia experiences, the problem of copyright, and the role of guerrillas in the garages (i.e., independent small-scale innovators). Max Whitby speaks of a literacy of composing and the need for tools to help users become composers. Stewart Brand expects to see much of the production of multimedia developing in grass-roots activities within amateur and outlaw areas. Bill Dunn compares the present Roundtable to two chance events in past decades that turned out to be pivotal to the growth of Dow Jones and its successful adaptation to modern times. Finally, Hans Peter Brondmo appeals for a concerted effort to model and systematize multimedia content, in the process of which he receives a lesson in the perils of being a graduate student.

■ Whitby

The title of this session is, very appropriately, "To Be Determined." This reflects precisely the state we are in as a nascent industry.

The discussion we had about telecommunications earlier reminds me of the apocryphal mayor from a small town on the east coast of the United States who attended a world's fair towards the end of the last century. He was shown into a booth where he received a demonstration of the telephone, a new and amazing technology which was then the equivalent of multimedia today. After the impressive demonstration, the wide-eyed mayor staggered out of the tent and, in front of the assembled group, made a very bold prediction. He declared, "I would not be surprised if within a hundred years there were a telephone in every city in America!"

We are in exactly that state now with multimedia. We simply cannot comprehend the range of applications people will find for new technology once it's in place.

As a television producer, I'm one of those people who manufactures what's called *content*. (It's a bit like thinking of architects as people who assemble concrete.) Alan Kay, with his customary sharp observation, brought up an absolutely central issue for all of us here, coming from the many different directions that we do. How do we design experiences which are really going to be attractive and appealing to consumers of the new media? I want to address this issue.

"To Be Determined" is going to be a very eclectic session. The panelists will be making a variety of different points, and it will be an opportunity to confront issues that have been bubbling up in the other sessions. I will get us started by talking about this matter of designing experiences. It bears on a number of the topics important to us.

Let us consider the market into which our new products will be entering. Many of these products will be competing with existing media; in particular, with television. Television has become a fundamental part of our culture. People have developed an extraordinary literacy in consuming its high volume blast of images and sounds. If multimedia is to succeed, then, in an evolutionary sense, it has to be naturally selected. We need applications for the new media which will do well at attracting consumers away from the linear television so prevalent in our society.

One of the striking features of television is that it's easy and seductive to consume. You get home tired at the end of a long day, sit down, and turn on the set. You actually vanish from the room. You get so absorbed in the tube, you're carried along. Thinking, to some extent, is done for you.[38]

What we are proposing now — and this is essential to the new media — is a much more active, participatory form of publishing, where the consumer is encouraged to think and to make executive decisions and choices. Discovering a way to make interactivity attractive and preferable to sitting back and watching linear television is the greatest challenge we face. To succeed in getting such forms of communication to genuinely supplant linear media will be extremely difficult. Indeed, it will be inappropriate and ill-advised in a whole range of application areas, including some in the home.

Now let us think of the very early examples we've seen that have succeeded. *Beethoven's Ninth* is certainly one; it's a milestone. There are others we haven't mentioned yet. Considering them may hint at a grammar that would be effective for delivering material in the new media.

[38] "[T]he average viewer does not watch a program per se, but rather watches *television*. The viewer plops down in front of the set, spins the dial, examines the programs available and selects the least objectionable. Surveys repeatedly confirm that most viewers report watching *whatever is on*. . . . I conducted a study of the ability of California viewers to recall stories from the evening's network news by interviewing them that same evening by phone. On the average, viewers could recall only 5% of the stories without additional prompting. This corresponds roughly to research on the recall of commercials." [Russell Neuman in Greenberger, *Electronic Publishing Plus*, p. 7 (See Bibliography)]

(Whitby)

One particularly important idea is the notion of guides: finding a way to publish the knowledge of experts in a form from which the consumer of information can selectively choose. Another approach, which begins to marry interactivity with linear media, is the notion of making users and consumers of information into composers. From the many times I've spent editing and assembling films in a cutting room, I know the process of making a television documentary is, in itself, an extremely informative, interesting, and fun way to learn about material. We can begin to take that experience, which currently is very guarded among a small group of experts, and extend it to the rest of the world by building simple, easy-to-use tools. I think we will then have a very significant way for users to learn by getting their hands dirty, as it were, with television, sound, graphics, and animation.

A third promising approach is interactive story telling. Along with *Beethoven's Ninth*, there are now some very interesting examples on the Macintosh. *Cosmic Osmo* [39] hints at things to come. It's an interactive world within which children can explore and wander. Every place they go, there are devices that work and things to do. The creator of this world is telling a kind of story. Voyager Company's Amanda Goodenough stories of Inigo the Cat allow a child to follow a number of different paths that essentially tell many different linear stories which interweave. The experience combines authorship with the freedom to choose.

An objective for the work my group is pursuing with the BBC in London is to encourage people to learn, not by watching television, but by making television themselves. I think there will be a new kind of literacy in the last decade of the century: a literacy of composing over time. Up to now, computers have largely provided spatial, functional, software tools for doing word processing or working with spreadsheets. We are now seeing a profound change as the software begins to absorb information and provide

[39] *Cosmic Osmo* and *Manhole* are interactive HyperCard programs for children available on computer disks from Activision.

entertainment. An extremely important direction will be the creation of experiences from this material, sequenced over time, having streams of sounds and pictures, and telling a story. One of the most significant actions we can take as a publishing industry is to find experts in other media who have particular stories to tell, like Robert Winter and Bob Abel. As we give them the tools and machines to express themselves in an interactive form, the literacy of composing will flourish.

Brand

When my associates at Whole Earth produced the *Electronic Whole Earth Catalog* about two years ago, I got an over-the-shoulder glimpse of how labor-intensive the medium is. Done in HyperCard, using 10,000 cards, the project took an estimated one person hour per card. Apple Computer and Broderbund spent $150,000 on the project. (It had to be a loss leader for them.) The electronic catalog is without color, or even gray scale. There is no video or real animation, and nothing in the way of decent co-authoring by the user. And it's slow — not as fast as the printed catalog for getting something wanted *now*.

What's good about the electronic version, and what excited me, was the ability it offered to store 400 pieces (several hours) of sound for mail-order buyers to sample — music, bird songs, books on tape — something the old *Whole Earth Catalog* could not do. We went the opposite of *Beethoven's Ninth*: from text to sound. That was the big breakthrough for us. Robert Winter, much more correctly for his purpose, went from sound to text.

The Whole Earth disc has sold about 3,000 copies in the two years it has been out — not exactly a runaway phenomenon. One problem is that it requires the Apple CD player, which has had relatively limited distribution so far. The need for equipment is one constraining factor on the medium. Another is the hassle of copyright, which we got around the same way we had with

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the original *Whole Earth Catalog*. We waved our hands and said, "Fair use, fair use; this is all review." The *Whole Earth Catalog* is almost entirely other people's words and pictures, which they let us use because we were pointing at their product. Every now and then some author's lawyers would get in touch with us to complain that we were robbing their stuff. When we asked what they were planning to charge us for damages, they would go away. We spoke earlier about using multimedia either for browsing or as a preview medium. In a way, its most natural use is as a preview medium. It's great for shopping, and this provides the best way around the hassle of copyright. Reward the people whose stuff you're stealing.

As a study medium, where the user wants to have comprehensive access to a whole book or piece of music — and be able to probe several levels behind it — multimedia is more problematic. Having to get copyright approval for all those levels is expensive and tiresome. Here the solution may be the library. It's the only legitimized body of information in American society that insists on being free. The library makes it legal to appropriate and pass around information in a casual way. This is viewed as a good thing for civilization — and it is.

By the way, I found that it was not industry, but the libraries who were most responsive to my book on the M.I.T. Media Lab. Libraries want to blend everything together, just like the Media Lab does.

Multimedia production is so labor-intensive and copyright-tangled that we can expect much of it to develop in the amateur and outlaw area, analogous to grassroots explorations with personal computers, satellite dishes, and VCRs. Leakage of information has been discouraged by the big players, shrugged off by the small players, and leaped at by the large number of tiny players. So, we can count on strong growth occurring in the casual distribution of information. In this respect, business will not lead the way; kids, hobbyists, and artists will. A primary accelerator, if one is desired, would be

interactive broadband to the home and studio. We may have the apparent anomaly of hypermedia *preceding* hypertext into public use, with commercial application and refinement following behind at a dignified and befuddled distance.

Hobbyists will help carry developments forward. As a side note, the set of hobbyists I watch most closely are the sexual hobbyists. (I am a biologist by training.) Amateur commercial pornography is booming. There are several national distributors, each with hundreds of titles. On network TV, one of the top shows is America's *Funniest* Home Videos, while down at the porno shop they're selling America's *Horniest* Home Videos.

I agree with Reese Jones and Nolan Bushnell that we should promote low-cost, take-your-chances authoring systems. Production could really take off if broadband comes more quickly than expected. Consider the facsimile machine, which is kind of a pseudo broadband and obviously an *interim* technology (*interim* toward what?), and yet such a big success. Bam! Suddenly, there it was!

A great deal of pressure is being placed on Judge Green. (He may not have to die.) So many people hate cable TV and are impatient with newspapers. They're pushing for glass in the ground and to the home. We might get an administration voted in on a platform of rebuilding the *infostructure*, as well as the infrastructure of America, similar to what occurred with interstate highways. Nicholas Negroponte tells me that Japan plans to have 100 percent fiber to the home by 2010. Americans respond to this kind of challenge. It could happen quickly. Things could take off.

The deciding factor might take the form of a trade. Congress says to the Telcos, "Okay, we know most of the money in the phone business is in Yellow Pages. You get to do *electronic* Yellow Pages, but you've got to get the glass out fast — everywhere. (Newspaper people, sit down; sorry,

(Brand)

you've got other stuff to do.) And by the way, we'd like a fair amount of flat rates so people can start having co-presence at a distance."

The innovations brought about by such a trade could be vast, going well beyond multimedia.

■ Dunn

First, let me support what Nicholas Negroponte says before he attacks me.

We all know change can take a long time. We tend to overestimate the short-term impact of an anticipated change. When the change or impact does not arrive on schedule, we just as mistakenly then overlook the longer-term implications. The computer companies who arrogantly declared there wasn't a home computer market, for example, are now helplessly watching SEGA and Nintendo take it away from them.

I represent a content company that's trying to make a profit. The rule in the corporate marketplace is to be profitable. Although we are not insensitive to other problems, like educating children, profitability is the rule to which we adhere. At Dow Jones, our profit margins happen to be considerably higher than much of our competition.

We have a fairly easy market to sell to — corporations. They are concerned about losing their competitive edge and are beginning to realize that external information — competitive information, psychographic information, census information — is very important to them. Our customers feel they need increasing on-line capability. In the very competitive environment in which we operate, we have to make certain we don't get stuck just being a newspaper company.

Listening to Robert Winter and Bob Abel reminded me of a visit we made to Comsat in the early 1970s. Comsat was an organization with new satellite technology and razzle-dazzle — like *Beethoven's Ninth* and *Ulysses*. Its pitch was that the satellite would be used with a television camera by a doctor at the Mayo Clinic in Rochester, Minnesota to diagnose a young Brazilian boy on the U.S.S. Hope. Other applications sounded equally intriguing. But we could not figure out how the technology could impact us at Dow Jones.

So we began a process of discussion. Comsat had no idea of what we were trying to do. We had no idea of what we were trying to do. We ended up building a new distribution model for a newspaper. We started with a 56 kilobit line; now it's 65 megabits! (We wouldn't have understood 65 megabits then.) We started with single-carrier-per-channel, broadcast only. Now we are fully interactive, with time-division multiplexing (TDM).

The satellite gave us the ability to reflect information, amplify it, saturate every square inch of the United States, put a lens to the signal, and begin to publish. During the 1970s, Dow Jones doubled its printing plants and, as a newspaper, the *Wall Street Journal* had its most significant period of growth ever. It all arose from a happenstance, like this event here today. There, as here, our purpose was trying to understand.

In the 1980s, Dow Jones experienced a second period of major change and growth. It was triggered by Mike Markulla, an early leader of Apple prior to John Sculley. Markulla came to visit us in the late 1970s on a red-eye flight, carrying an Apple II, a modem, and a program Bill Atkinson had written to access our new quote service. (The program was on a cassette tape because Apple had not yet received the floppy disk it was hoping for.) What Markulla demonstrated to us, we felt, was a potentially new distribution mechanism that would let customers get what they wanted, when they wanted it, in the manner they wanted it. This was completely different from

(Dunn)

the arrogant publishing model of a newspaper, where we put in everything we think is wanted in the form we think it's wanted, and then have the customer come to get it either at the end of the driveway or at a store.

That was 10 years ago. What it did to Dow Jones was completely change the structure of the company. In the last decade, the print side of the company has doubled its revenue, while the electronic side has grown by a factor of from 7 to 22, depending on whether you include our Telerate acquisition. Today over 40 percent of revenue and 68 percent of operating income comes from electronic forms.[40] The whole structure of the company has shifted — almost as a by-product of dabbling with a rather bizarre technology called the *personal computer.*

Information surrounds us. The book *Information Anxiety* points out that a weekday edition of the *New York Times* contains more information than the average person was likely to come across in a lifetime in 17th-century England. The Connection Machines that we bought at Dow Jones process information at a rate of 120 million words a second. How many editions of the *New York Times* is that each second? How many lifetimes of information only 300 years ago?

Some additional statistics: More information has been produced in the last 30 years than in the previous 5,000. Every day 1,000 books are published internationally. Printed knowledge doubles every eight years. There are currently 200 billion characters on-line. We estimate one trillion characters by the end of the decade, the equivalent of 5,000 years of the *Wall Street Journal*! And that's just text, not sound or visual information.

[40] Dow Jones revenue
1980 — circulation, advertising, other = $500 million; electronic = $30 million
1989 — circulation, advertising, other = $990 million; electronic = $695 million (with Telerate), $200 million (without Telerate)

Gordon Moore of Intel has called us an *Eighth Level* company — dealing in the *stuff of the mind* — above technology at the Seventh (application) Level. We rest on the topology that others build. Dow Jones, as a provider of content, doesn't control developments, and only influences them to a small degree. We have to adapt to the technologies our customers select. In our data broadcasting and interactive services operations, we have to be compatible with many computers, applications, networks, and search preferences. Our customers depend on us to set an agenda of important business and financial news and issues. That's been our main function.

A whole new economic model of the information company is forming and needs greater understanding, even by those in the business. The 386 chip that Intel manufactures produces eighty percent of its profit, yet occupies only five percent of its manufacturing capability. Information companies can produce the *stuff of the mind* for very little, store it in electronic form for even less, then clone, adapt, and transmit it for virtually nothing. The value is in the eye of the receiver. This isn't a model the publishing industry has ever before experienced.

What do our customers want? We are now in 75 percent of the Fortune 1,000 companies and 85 percent of the top 100 banks. We have over 300,000 customers on-line, and we are growing. Our customers are beginning to expect everything from us on-line: more global information, census data, marketing and psychographic information, anything that can help to explain the environment they're in so they can become more competitive. They are willing to pay — but they're willing to pay more for opinions and interpretations than just data. They have a desire to know.[41]

[41] "In a knowledge-based society, information is the key resource and building block for every type of organization. Knowledge workers will take their place, the ranks of middle managers will thin, workers will be more mobile, and executives must learn to manage large numbers of specialized workers much as a conductor leads an orchestra." —Peter Drucker, "The Information-Based Organization," Chapter 26 in *Frontiers of Management*, E.P. Dutton, New York, 1989, p. 203.

(Dunn)

Do they want multimedia? I think it would be presumptuous for us to assume they do. But, whatever the case, Dow Jones has got to be into television and image capture. What happened in Tienanmen Square had an impact on the Hong Kong stock market as it was seen on television. The market was watching that young man standing in front of the tank. When a market crashes, viewers flock to watch the television reporting from the floor of the exchange to obtain a word-by-word account of the fall. At the time of the earthquake in California, people were buying shares of Lone Star Concrete, based on television pictures showing highways collapsing. They didn't need to be told more cement was going to be sold.

If Dow Jones is going to continue to report on business and financial news, it must have a way to capture the imagery, distribute it, and somehow integrate it into the mind space in the limited time investors have available. The reality is that there are still only 24 hours in a day.

■ Brondmo

I would like to focus on the notion of *content*. Some have remarked that the phrase *multimedia* doesn't mean very much. The generic use of the word *content* doesn't mean too much either. What we need is an agreed-upon means of describing content. We need ways of extending architectures and providing open-endedness, as discussed, but with content models that allow us to start sharing information produced for the end-user. I'd like to suggest, in the local lingo, that the design of a suitable content model be the agenda for an action program coming out of this meeting.

I think four points are essential. First, since we don't yet know the meaning of content, or how to describe it, a content model must be open-ended, extensible, and saleable. Second, the model must address the issues of

intellectual property and copyright by guaranteeing that copyright notices and identification of owner and source always remain with the material being distributed.

Third, the content model should provide a clean, low bandwidth migration path from analog to digital. In particular, a content model describing common file format, using the digital environment to affix copyright notices, would inform the user on where to look for source material. The quality of a low-bandwidth, digitally produced work for imagery and video will probably be lower than that of the original analog source. Copyright tags would not only provide a service to the owner, but to the user as well, especially the user intending to distribute the material as part of a commercial product. This is the user most interested in going back to the higher quality source, and therefore is the user about whom the owner would probably be most concerned.

Finally, the content model should explore how supplementary information can be coded with content and made computer-understandable. What I have in mind is inserting into the stream of video more than descriptive and key words, which don't necessarily add much. We have to look at how content can be described in a way which allows the computer to really start adding value. The overall goal would be to develop a model that content providers can apply pragmatically — a model that allows them to work with all of the new tools and products coming out.

I've been trying to think of an analogy. Suppose we could only read books with a machine. If the machines sold by manufacturers didn't have compatible file formats, every time we bought a book we'd have to make sure it was compatible with our own reading machine. If it was incompatible, we might still be able to read the book if we had access to some kind of format conversion routine, or to someone else's machine. If we didn't, we just couldn't read the book.

(Brondmo)

Obviously, this wouldn't work very well. Books would not have caught on nearly as well as they did under these circumstances. The point is, it would be very useful to find an open-ended (book-like) model for multimedia formats, and build standards according to it. Then we could begin sharing multimedia information and describing it in a way that makes it generally usable.

Whitby

Let's try to focus the discussion a little. Does anyone care to comment on Hans Peter's suggestion about developing standards in multimedia publishing for describing content and designing tools?

Kay

In the 1960s, much of computer research was paid for by the U.S. government, and the findings were in the public domain. The Mansfield Amendment shut down this particular kind of funding. It left us with the National Science Foundation, which, because of its process of peer review, provides scant support for computer projects of a maverick or highly innovative nature. Needed research on computer standards and multiple platforms didn't get done in the universities as a result. It was left to industry, with unfortunate consequences. Companies are not motivated to work on hardware-independent development systems. Today, I think the level of technology for doing automatic optimization is getting to the point where it's actually possible to think of dealing with numerous different platforms, even though many are inadequate. We should look at these possibilities carefully. The companies are certainly not going to have an interest in providing ways for moving applications from one platform to another.

Seybold

I usually agree with Alan, but I'm puzzled by his view that research on standards should have been done in the university. I don't see the standard-

setting that's taking place in the same way he does. I think the evidence so far in the computer industry is that the winners are the companies that set the standard. They're the leaders, and the other companies follow. That's exactly why computer companies spend so much time in sumo wrestling, banging up against each other trying to be the one to set the standard.

Kay

I think it's terrible.

Seybold

But this is what's happening in the industry, and there's commercial advantage. That's why it's done this way. What concerns me, for the content providers, is that we're so early in this process for multimedia that it's hard to see how long it'll take to get through and have the standards set. There's a real risk that if the standards are set too early, they'll be set at too low a level.

Kay

There's a Gresham's Law in our business that bad designs drive out good ones, since it's almost always possible to get a bad design to market earlier. This happens over and over again. There may be charitable ways of looking at it, but MS-DOS is just a polluter. It did not need to exist. It was the way operating systems were designed in the early 1960s. There have been better designs since then which could have been used, but the responsible parties apparently didn't know about them. Because of one company's clout, we have a situation today that's worse than just trying to develop something good. We have to try to displace something bad and endemic. It's like COBOL all over again.

Brand

I find myself deploring, along with Alan, the lack of funding for deep research. As he made the point, I realized that it constitutes still another pressure for guerrilla activity. If NSF-funded research is conservative

because of peer review, and company research is conservative because of bottom-line priorities, this leaves the garage guerrillas. They might form interesting coalitions. They'll certainly grab at any good tools that come their way.

Glaser

I was loathe to tackle the standards issue while I was chairing a session, because it's so divisive; but let me try now. It's ironic. Clearly, a defining characteristic of the personal computer industry is the rough-and-tumble way standards get developed. Not a single meaningful standard in the industry, except possibly Ethernet, came through an international standards organization. Everything else — communications standards, personal computer operating systems, bus architectures — came via the *de facto* path. That terrible method has gotten us an installed base of 45 million systems, a high percentage of which use the awful 1960s-style MS-DOS operating system. It's bootstrapped an industry to the point where we can now have a discussion of what to do next.

At Microsoft, we spend a great deal of time working with the hardware manufacturers to create coalescence. There's a real tension between having that coalescence be a lowest common denominator that a critical mass will agree to, or having it be forward-looking — something with unity and coherence that pushes the state of the art, but not something to which everyone agrees. We do a bit of each.

One of the main contributions Apple has made to the industry over the last ten years is pushing forward the state of the art by taking a stand — not pretending its machine would literally be compatible with anyone else's, but ensuring it would be coherent. I'd like to throw the gauntlet back to Alan Kay. Isn't it about time for Apple to play a similar role in multimedia, not, as John Sculley said, two to four years from now, but shorter-term? Do you think it's possible? Or is the technology too far out?

Kay

Fortunately, Apple doesn't regard me as a spokesman for its cause, so this is just my own opinion. In an area where we don't completely know what we're doing — and it's clear we have not reached a plateau in multimedia — it should be possible to get incompatible things out there to compete. That's how we learn. When it was hard to build computers, every university built its own. Now that it's easy, even companies are reluctant to build incompatible CPUs. (Wall Street doesn't like it.) There's a much larger feeling of risk now that the entire computer can be put on a chip. Thirty-five years ago, it required plugging in vacuum tubes for two years to make a computer work. The adventurousness of the field has changed greatly.

There's a saying in Silicon Valley that the only people able to make a standard are too dumb to invent a good one. That's happened with almost every standard we have. From my perspective as a musician, the MIDI standard particularly drives me crazy. There was no thought given to making it universal. It was designed by a few keyboard players and has nothing to do with music, just keyboards. What MIDI requires to encode the nuance of a trumpet or violin is horrendous. But it's a fact of life. I just deplore it because I'm an idealist.

When John Sculley and I started talking in 1986, I said, "John, your main goal for Apple should be to come out with something incompatible with the Macintosh before 1995. This is the only way Apple will avoid becoming another Digital Equipment Corporation."

Jack Sculley

I'd like to make the point that neither technology nor content is the key to multimedia. The capabilities of technology always run ahead of their application, and interactive media is no exception. Nor is content a constraint. It exists in books, periodicals, and many other sources. It's what's done with the content that's important.

When we were working on the *Life Story* project under the collaborative sponsorship of Apple, LucasFilm, and the Smithsonian Institution, our student users told us what they found most valuable.[42] It was *not* the comprehensive listing of terms in molecular biology we'd put together, *not* the interviews we'd collected from a number of different scientists, and *not* the simulations of DNA replication we included. It was the power the students felt to put themselves into the scientists' shoes and form their own connections. They could compare their own points of view on molecular biology with those of Watson and Crick, while trying to figure out the source of the flash of insight that enabled the two scientists to unravel the secret of DNA.

The point-of-view experience is critical. Maybe it didn't cause the students to want to go out and decode alpha helixes. Maybe they wanted to do genetic counseling instead, or pursue implications in literature. The important point is that we're dealing with understanding, knowledge, and feelings, not just information and facts. We need to invest money in that pursuit and free up the time of producers to work on it.

Now for some confessions: First (this is embarrassing), we seemed to be spending most of our time getting the right cables together and fixing the machines. Much of the technology simply did not work. I'm all for *guerrillas in the garages*, but what I need are Samsonite *gorillas* in my garage to crash test my multimedia machines. I just spent a week in Washington carrying around 100-pound Anvil cases, because I didn't trust anybody else's equipment. I had to bring everything with me. I'm sure there are more productive uses for my time.

Second, we spent most of our money on copyright, not production. Production was expensive, but obtaining the rights to material cost us more. Unless we're going to ignore the body of information that's already out, we have to deal with repurposing material. Unfortunately, no mechanism exists for

[42] A twenty-minute videotape on the creation and classroom use of *Life Story* is available from Apple Computer.

that. We spent time looking for dead Russian composers' music we could use. It was crazy.

We need help resolving issues of copyright and the use of repurposed information. What is intellectual property? Should a small producer be liable for scanning an image, changing it around, and creating something entirely different? Where is the borderline?

We also need help in evolving a more realistic standard for low-end production. People are spoiled by television and LucasFilm. They think multimedia is "LucasFilm on a desktop." An affordable standard would encourage more small-scale producers to enter the field. Scratches on a great film are hardly distracting.

The focus should not be on the technology when we demonstrate our work. We've failed if the viewer says, "How did you do that? Oh, that was neat! What board did you use there?" Then we've obscured the content. We've put the process in the way of the substance. Ideally, the technology should be invisible.

What Bob Stein and Max Whitby said about creating experiences is key. We need to remove the interfering distractions so producers can spend more time designing these experiences. That is where our investment should go.

I also deplore the lack of funding for noncommercial projects. With *Life Story*, we were well funded, but this was atypical. In the world of education, there is no mechanism for financing "strange" or offbeat innovations. I spoke to an aerospace executive about funding a science project I'm working on. He said, "We'll give you $2 million to do a training system for us, but we can't invest in education right now." I said, "You may not have any employees to train in twenty years, because you're not getting a base level of technical literacy in the schools." He replied, "That's not our responsibility; it's the government's. The government needs to take the lead."

The traditional review system is too conservative to approve most multimedia proposals. With our current project, *The Mars Explorer*, we've broken ground in getting NASA and the Smithsonian Institution involved. We hope this will set a precedent for other production houses. To empower the creative talent in small firms as well as large, there will have to be linkages among government, private industry, small producers, and the owners of content. I hope out of this meeting will come realistic plans for evolving structures to meet these needs, so people like Robert Winter and Bob Abel will not have to spend most of their time dealing with peripheral issues.

Negroponte

I want to rewind to the previous conversation on standards to urge that we not worry about them, because we will increasingly not need them. The trend is in this direction. Look at the fact that we have 50 hertz, 220 volts in Europe, and 60 hertz, 110 volts (or so) here. Every PC manufacturer now markets a computer that can plug into the wall and tell the difference. This turns out to be nontrivial, since it's in the analog domain. In the digital domain, it will be much more straightforward. We'll put some information on the disk that tells how to read it, or what to do with it. If we have to standardize anything, it's the diameter of the disk. We should do the opposite of what was done for fax machines, where they standardized the telecommunications, but left every manufacturer free to use a roll of paper with a different diameter, length, and width. We should standardize the paper — namely the disk and its diameter — and let the computers do the rest.

Whitby

But do you think it's realistic for the software that replays the information to standardize of its own accord, without our agreeing on standards to be imposed externally?

Negroponte

Absolutely.

Glaser
Would you like a job in our group doing software development?

Jones
A pragmatic problem with letting computers do standardization on the fly is that the cycles used in converting from one format to another can end up reducing the quality of the end result. Farallon's SoundEdit software reads over 200 different sound file formats. The problem comes in moving towards video and other areas that are computationally at the border of what the hardware is capable of today. On lower levels, like converting to ASCII format, the computer does the conversion effortlessly. But there will always be a bleeding edge where achieving standard independence means throwing away some quality.

Negroponte
That's not completely true.

Kay
I might just mention that one of the major impetuses for the invention of object-oriented programming was to try to get away from standards. At a meeting of ARPANET users I attended, they were trying to define data formats for transmitting information among different machines. I couldn't imagine why they would want to even try doing this, when they could encapsulate the information so that it carried its own standard. (That's what Nicholas is alluding to.) It's also what I objected to at the meetings in the early 1980s on what CD-ROM and CD-I should be. The standard they were proposing was completely backwards. They didn't seem to believe there was ever going to be a computer reading that disc, or they didn't understand what that computer could do. They thought of it like a Victrola. With an object-oriented approach, these problems are subsumed. It's a question of the paradigm adopted, much more than whether or not there should be standards.

Whitby
Hans Peter Brondmo wants to make a point.

Negroponte
Be careful. You have to graduate.

Brondmo
I worry about that. I will start by saying I couldn't agree more with Nicholas.

Negroponte
It's a step toward graduation.

Kay
I don't know. It might be the wrong thing to say.

Brondmo
I probably shouldn't have used the word *standard*. What I was recommending was the modeling of content. Regardless of the application, with bits streaming into the computer, we need models. The computer might create them locally, according to how the information is to be viewed; but we do need them. Since we don't have them yet, it's going to be a jungle out there for content providers trying to use the computer to add value to what they're supplying. My point is to propose an action group that would simply pool what we know today to try to determine what suitable models might be like.

Arnett
What I think I'm hearing are points about the level at which standards should be defined. In what Nicholas is talking about, the computer must be able to have information telling it what the standard is. In an object-oriented language, the objects must communicate with one another, which requires standards. Can you explain this better?

Kay

It's outside the scope of this meeting, but it's a little more subtle than that. What's interesting is that you can be subtle within this technology.

Arnett

I think of multimedia as taking personal computers out of the realm of being primarily information-processing machines, and turning them into information-processing *and* audio-visual/electronic communications machines. When we do communications, standards seem to be utterly essential.

Jones

The standard should include notification that the computer has the legal right to read the data. Standards are starting to appear in the industry that are illegal for the computer to read, even though it's capable.

Abel

Since I'm allowed to have the final word, I want to say I've found this session incredibly interesting, and some of the remarks extremely sensitive and insightful. John Sculley has suggested that we should move more and more out of software and into the hands of artists. There are many, many artists out there. We've just begun to find a way to get them designing for multimedia.

When I first came to visit Max Whitby in England, and saw the fantastic tools he was creating on his own in his house there, I thought, my God, what a powerful experience to give people! Just like a film can expand and compress time, multimedia can expand and compress thought — in potent and dynamic ways.

Robert Lucky, Moderator
Miles Gilburne
Steve Mayer
Bob Brannon

This was a spirited, freewheeling session, ranging over considerably more territory than merely business applications. The session opened with an introduction by moderator Robert Lucky, followed by short presentations by Miles Gilburne, Steve Mayer, and Bob Brannon, each giving a different slant on the subject. Then the scope widened, touching on information overload, the digitization of text, and the future of the library. Richard Lanham raised some hackles when he said he felt like "the humanist bastard at a scientific family reunion" and declared the discussions were overlooking or ignoring current studies in the library field and a long tradition of historical discourse in the humanities. The sometimes biting exchange that followed recalls C.P. Snow's "two cultures."[43] It was not until Michael Quinlan's extended commentary at the end that the focus returned to business applications. Quinlan, given the last word, made the most of it.

[43] C.P. Snow's "two cultures" were the literary and the scientific. (See Bibliography)

■ Lucky

This session is on the business environment. In business, such things as entertainment, the sharing of experiences, the focus on understanding, art, and emotion — subjects in the other sessions — don't count for a lot. Not to rule them out completely, but in business, it's the bottom line that counts.

What business is looking for is access to information. My company, AT&T, has been in the communications business for a long time. Over the past hundred years, we perfected a *unimedium*: a single medium for communicating voice. People have gotten so good at using it that it will be hard to displace with a multimedia format.

AT&T would like to expand the bandwidth of communications to provide information through pictures, motion, sound, and text, as well as voice. The capacity required to do this is well along. Local area networks are up to 10 megabits for Ethernet and 100 megabits for FDDI. Optical fibers provide similar bandwidths for wide area networks. And computing technology is very advanced. In short, technology isn't the problem. Our business failures have been from a lack of understanding of the human aspects of communications, not from a deficiency in technology.

When the telephone first came out, people didn't want to use it. They didn't know how to use it. They had to learn. And they learned very well. But people have not yet learned to use non-voice modes of communicating.

I had a Picturephone for several years. The Picturephone was one of our failures at AT&T. In 1971, you could buy a Picturephone for $125 a month. Basically, nobody wanted it. I think I had the last one in the world. There wasn't anybody left to call.

There are some lessons in Picturephone. People would complain that they had to comb their hair to answer the telephone. Personally, I found it a very intrusive technology. It was like sitting at home on a Saturday afternoon and

having the doorbell ring. It intruded into my life. The normal telephone intrudes some, but not nearly as much as the doorbell.

We're used to dealing with the telephone. Because it's a unimedium, it frees us to do other things. I type very quietly at my terminal while I talk on the telephone. Every now and then someone says, "I hear you typing," but that's okay. When I used a Picturephone, I had to stare stupidly at the instrument and it consumed me. At the end of a call, I was tired. I didn't need this. All I wanted was information.

In the 1960s and 1970s, human factor and cognitive psychologists studied the value of pictures when what one wanted was information.[44] I don't think they do these studies anymore because the results were so discouraging. Basically, they found pictures didn't add very much. If two people were given a task involving the exchange of information — with a telephone in one experiment and a Picturephone in another — the time it took to do the task was the same. Adding video didn't shorten the time or noticeably improve performance over audio alone. The same result held for many different kinds of tasks. Leaving out emotion, art, and other higher-order interests, and just concentrating on exchanging information, it was hard to find what the visual medium added.

This is a paradox. They say a picture's worth a thousand words. And indeed, from the standpoint of communications capacity, the bandwidth required to send a television picture *is* a thousand times that to send voice. Yet a picture clearly is not worth a thousand times as much as voice.

Consider the Encyclopedia Britannica. As pure information, it is digitally about one billion bits. In the current edition of the encyclopedia, about 90 percent of these bits are pictures. If you were to remove the pictures, how

[44] See A. Chapanis "Interactive Human Communication," *Scientific American*, 1975. 232(3), 36-42.

(Lucky)
much information would you lose? Very little. Yet, if you were to remove the 10 percent of the bits that carry text, you would lose almost all the information. That is not to say the pictures should not be there. They add interest and vitality. But, allowing for obvious exceptions in radiology, meteorology, and spying, pictures do not ordinarily carry much of the information. In the normal business environment, most of the information is carried not in pictures but in words and text.

Another lesson: AT&T had the idea about five years ago of mounting video on the walls above the desks of executives to provide them with releases of the latest information. It didn't take long to see that no one wanted to sit there wading through this serial medium, typically 20-minute video tapes. If the typical person in business cannot get to what's needed right away, forget it. This is the age of *USA Today* and *McPaper*. Information has to be crunched down to minimum form. It has to be human in the way it's made accessible. We've had many disappointments in our business by failing to do this.

Home Information Systems was a failure for us.[45] So was the interactive videodisc business. We did not realize how much work and money had to go into editing a disc to make it decent. We put enormous effort into one of the first interactive videodiscs for the Epcot Center at DisneyWorld. Even so, it wasn't very good. I don't discount the fact that putting a lot of money into a small amount of material, as in TV advertisements and business applications for training, sales, and maintenance can be effective. But it will not work for day-to-day information exchange.

In spite of these misgivings, I do think multimedia technology has great potential. At AT&T, we are working on systems for using the expanded

[45] Outside of *Minitel* in France and perhaps *Prodigy* in the United States, market acceptance for computerized information services to the home has been slow in coming, as described in the "At Home" chapter

bandwidth in communications to let people share visual spaces at the same time they share audio spaces: to enable two people at a distance from each other to look at the same document, write on a joint blackboard, have individual pointers, and leave messages for one another in the form of speech or video.[46] I'm not sure how these features will be received in a busy business world, but I'm certain their use will have to be learned before they will be of any value to us.

The technology is here, but the understanding of how visual systems enter into information gathering and exchange is not. Exploring the possibilities makes for challenging and enjoyable work.

■ Gilburne

As a venture capitalist who's spent several years investing in tool and content companies in high-tech areas, I have a somewhat different perspective than most. What I'll do is walk you through our strategy and rationale for investing several years ago in MacroMind, a company well known for its high-end multimedia authoring tools. A very important part of our investment strategy was the desire to put down stakes in an authoring system. We decided to jump a generation by investing in MacroMind.

In looking for co-investors, I encountered the general belief that there simply wouldn't be a market for multimedia tools for several years. People were just beginning to move from black-and-white on the desktop to still images and color, and the digestion process would have to continue for some time before people could move on to the new data types of motion and sound.

Our assumption in investing in MacroMind was that multimedia was much closer to having the dynamics of dBASE than of PageMaker. With the

[46] AT&T has commenced a system called *Rhapsody* that provides a platform for interactive multimedia communications.

(Gilburne)
introduction of PageMaker, there was a whole group of people ready to leap into desktop publishing. New peripherals such as the laser printer suddenly hit price points that enabled these people to do page layout effectively. What followed was massive and quick adoption of a specific solution.

With dBASE, it was quite the opposite. The software required that a complex new skill be learned. A language was being marketed, not an application. The early users were all developers: third party service providers using the language to do new things.

In looking at where to put our stakes down in multimedia, we searched for a company that had the greatest control over developers. We believed developers would be the early adopters. They would be the service providers who showed what the tools could do. They would be the ones to introduce multimedia into the corporate marketplace. Massive adoption of the tools would follow. This would provide the opportunity for us to generate serious revenues.

At the time we invested, MacroMind had thousands of developers banging away on VideoWorks II. These developers were not creating high-end, broadcast-quality products. They were earning their living in the trenches, doing presentations for corporate America. We wanted to have access to their cottage-production expertise.

These developers knew how to take a lower-end platform like the Macintosh and push it to the limit. They knew tricks to make a system do what others did not believe it could do. They were able to squeeze every ounce of performance from the existing platforms. Most importantly, they understood the psyche of the emerging multimedia users and what kind of communication interfaces worked. In their projects for corporate America, they had been trying out different interfaces, templates, and ways to make presentations. They were developing a tremendous amount of non-rule-based knowledge about how to design terrific multimedia products.

We saw the MacroMind developers as good evidence of the collapsing distinction between artist and technician. What is going on now in multimedia is similar to what happened with lithographic art when master printers like Ken Tyler at Gemini, G.E.L. in Los Angeles learned about the new lithographic techniques and then worked closely with artists like Rauschenberg and Stella. Out of that collaboration came a new art form. We believed an investment in MacroMind was an investment in a relationship with just such a development group.

Our proposition for making money in the business market was, first, to deepen our entrenchment with this critical development group by creating progressively higher-end tools. With 3-D and interactivity, we could provide developers with increasing desktop capability compatible with how they were using our platform.

Our developers told us they needed the ability to cross platforms. They desperately wanted to deploy a training product or demonstration authored on the Macintosh on the large installed base of PCs. That has now become possible with the incorporation of MacroMind's player technology into Microsoft's Windows 3.0.

Platform companies like Microsoft are now taking over pieces of multimedia system software that small companies like MacroMind were forced to create to support development of their tools. MacroMind does not want to be in the system software business. What it and other small development companies pioneering ways to deal with new data types are interested in is getting ubiquitous distribution for their content. I think many of these companies are going to be just as eager as we were to deliver the system software their developers have been relying on into the hands of Microsoft, Apple, Sony, and other large platform companies. This has been a key objective of ours for the last two years. We promised it to our developers.

(Gilburne)

That, then, was the first part of our strategy. The second part has to do with ease of use. As platforms become more powerful and system software more capable, as we begin to convince corporate America of the benefits of multimedia, we want to create increasingly simple point-and-shoot tools so that end users can start doing their own rotating logos and simple presentations. The final part of our strategy will emerge as developers see their bread and butter taken away by groups within client companies. Developers, liberated from the tyranny of having to be service providers to corporate America, will be in a position to begin developing content. This will allow MacroMind to grow from a tools company into an even more substantial tools and content business.

We define content differently from most people. For us, development of content is going to be a highly focused and incremental process. In the early stages, developers will do things like creating the multimedia counterpart of fonts, such as buttons and clip animation for constructing multimedia realities. A major investment will go into that kind of content creation. It will be the antecedent of next generation tools to build sophisticated presentations.

We also think a narrow, vertical-market focus is a good way to explore content opportunities. The trend is toward cheaper and more efficient cottage production on the desktop. There is growing ability to target a narrow market — whether doctors, lawyers, or young children — using new delivery mechanisms such as optical media and ISDN. The opportunity is to begin developing channel relationships, through narrowcasting, with focused groups of customers whose needs become clearly understood. As customers start getting targeted information, they will be willing to pay more for it. Financing for content will be made easier because of the availability of partners interested in the same vertical markets.

Our view of content is very incremental. We will be looking to build rela-

tionships with narrow groups of customers rather than aggressively pursuing broad, horizontal markets.

■ Mayer

In 1455, there was probably a conversation that went, "Well, Mr. Gutenberg, besides the Bible, what else can you do with this technology?"

I had the good fortune to be with Atari at Warner Communications when Warner books, Warner records, Warner print, and Warner movies were all coming together. I went running around like a golden retriever with a new tennis ball barking enthusiastically, "I've got a new media, I've got a new media." They called me "the hypermedia person."

What really impressed me was how all these media with their own dynamics nevertheless have similar types of developmental processes. We were constantly rediscovering things that had been discovered in other media before. The best book on multimedia authoring is probably by Frank Thomas, on making cartoons.[47] He was one of the ten old men at Disney in the 1930s, doing work then very similar to current multimedia authoring. There is tremendous benefit in looking back to find what is common between the different media.

We talk about the good story well told. In his book on fairy tales and the use of enchantment, Bruno Bettelheim points out that the same stories keep coming back because they address fundamental needs.[48] People do not change that much. They relive the same stories again and again. These stories reappear in all media.

[47]Frank Thomas and Ollie Johnston, *Disney Animation: The Illusion of Life*, Abbeyville Press, 1981. Also, by the same authors and publisher, *Too Funny for Words: Disney's Greatest Sight Gags*, 1987.

[48]Bruno Bettelheim, *The Uses of Enchantment: The Meaning and Importance of Fairy Tales*, New York, Knopf, 1976.

(Mayer)

The first phase of a new technology often involves taking information from one medium and moving it to another. What made television initially successful was the ability to move 35 mm and 16 mm movies onto the video screen. Any new medium needs low-cost systems for authoring, display, and distribution. Right now, the cost of distribution dominates everything else.

We have a choice of the kind of model the new media will take. The film model produces 300 to 500 major motion pictures each year at substantial authoring cost. At the opposite extreme is the print model which publishes 100,000 books annually at much lower authoring cost. Print has many methods of distribution. It does not depend on the blockbuster book.

The new media are a bit different from these earlier media. Our first communications with primitive drawings in the hunt for saber-toothed tigers were concrete, immediate, and rich. (It was multimedia.) Then we went through progressively higher levels of abstraction, describing things verbally with text. At the highest level of abstraction (and the lowest point of Western civilization) came the punch card. Since then, we've been building back up, communicating at a distance, asynchronously, using more and more modes of communication, such as audio, visual, and touch. We can also now describe the context of information.

Somewhere in this process of building up came Marshall McLuhan saying, "the medium is the message." Part of our challenge is to show how the medium no longer needs to be the message — that the medium can actually disappear from the message.

An important difference is that the new media are contextual. There is a tapestry of information being woven. We can build incrementally from work done earlier. With the appropriate standards in place, each worker along the information food–chain can create incremental value, preserving whatever

information came before, to the next step and the next. With Nicholas Negroponte's idea of an open system in the home, and an adequate knowledge of the authoring and creation process, the final creation can be unfolded at home.

Standards are not necessarily physical. They can refer to the intellectual representation behind the information. With such standards, each company will be able to repurpose information and create value along the way. Within a single industry, standards have tended to be regarded as zero-sum. But when standards are between multiple industries, as in the case of desktop publishing, the game becomes more complex than zero-sum. One industry finds ways to add value while leveraging off the products of another industry.

■ Brannon

My feeling after listening to my colleagues is that multimedia is even more complicated than I thought it was when I took over Intel's Princeton operation eighteen months ago; and it looked really complicated then. We're faced with doing it right, producing value, and making money in the process.

The Princeton operation has had about 3,000 visitors in the last year-and-a-half. They fall into three types. The first are the OEMs that intend to build a box. The second are either application developers, content providers, or suppliers of a tool. The third are end-users who see something in multimedia (or DVI) and want to use it. These people have asked us tons of questions. I'd like to list some of these questions to see if there's a message in them.

The question visitors typically ask is, "When should I invest?" "When should I put my money into multimedia?"

(Brannon)

I've got a sign over my office, a quote from Tom Peters, that reads, "Test fast, fail fast, adjust fast." George Coates gave us a more poetic way of saying it: "Embrace uncertainty as an ally." No matter what we do, one thing is for sure. It will be wrong. The question is, how wrong, and do we have enough money to extricate ourselves quickly enough? There's always going to be something better, faster, or easier three years down the road. If we wait, we might be able to do it better. But it's unlikely.

My sense is that in multimedia the key battles will be fought in the next 36 months — if not the next 12 months. Those who take the high ground first, and survive, will own the high ground for the next decade.

Alan Kay noted that in this conference we are not using multimedia ourselves to communicate. We are speaking. I think that is good. I agree with Robert Abel that we are here to learn to work with each other without knowing the goal. My sense is that just listening to people talk and fight is a good way to get to know each other.

Another question that typically comes up with visitors to the Princeton operation is, what is the best way and where is the best place to enter multimedia? Is it the lowest-common-denominator machine that Microsoft has proposed? Or is full motion required?

Although this may sound self-serving, my own personal view is that full motion is not a choice, it's an imperative. I would not go to a theater to watch a sequence of stills, although I might for some degree of animation. There may be money to be made in animation and in a combination of animation and stills, but it will quickly be displaced as soon as we have an effective means to produce and communicate full motion. I believe the ultimate success of multimedia will be directly related to the emotional appeal obtainable from full motion, combined with animation, stills, and

audio. Investing in lowest-common-denominator machines over the next 24 months is a risky strategy.

The next question that gets asked is, won't the technology get cheaper and smaller? Or, should I hedge my bets by investing now and backing out later in a graceful fashion?

I think there will be options for recovering your investment. At Intel, we believe the fundamentals of silicon will drive multimedia technology and standards in two phases over the next 36 months. The first phase will be proprietary in the absence of ISO or CCITT standards. The second phase, with such standards in place, will require about a thousand million video operations per second to develop and deliver symmetrically, on a $10,000 machine, digitized super high quality video, stills, and audio in one component. That translates into a thousand transistors running at 50 megahertz.

In the next 24 months, the submicron technology we are developing at Intel will provide this kind of capability for the first time. The user will be able to have lower-level full motion video and audio for somewhere between 5 and 10 percent over the cost of a PC. Thus, in 1993, if a base PC costs about $1,500 in today's dollars, having full multimedia capability included would add perhaps $150 more. This still does not constitute a consumer product, but should provide an attractive product for the business market.

There are two fundamental choices on how to do this technologically: one is to hard-wire it, the other is to make it programmable. Most of what is being done now is to hard-wire it. Our experience tells us this is a mistake. It's better to make as much as possible programmable, even if that requires a 25 percent surcharge on the silicon or board. Programmability can then be used to adjust to a changing market, the latest technologies, or new algorithms.

(Brannon)

The last question is, for what will this be used? In the business environment, there are three promising applications. The first one is promoting products at point-of-purchase. Making everything digital and remotely available allows for smart advertising. Knowing what consumers have done historically can be used in promotions that are very personal. "Mrs. Smith, we know you bought Tide the last three times. We are going to give you 50 percent off if you buy it again."

A second area of active application is for training when and where people need it, such as do-it-your-way, just-in-time, or built-in/embedded training. A third area is productivity improvement. This includes putting systems on a factory floor where half the employees are not literate in the language of the factory's management. The ability to deliver engineering change orders to the floor quickly, using full motion video combined with stills and audio, in a language that the person who cannot read understands, should provide an explosion in the use of multimedia.

I will conclude as I started, emphasizing the inevitability of uncertainty in future developments. Peter Drucker expressed the problem a little differently than Tom Peters or George Coates when he recommended that we not innovate for the future, but for today.[49]

Glaser

I have a question for the panelists. Assuming we agree that multimedia in business is going to be delivered by personal computer, what needs to be added to the PC to make it viable as a delivery vehicle? What applications will drive these additions?

Brannon

Initially, just audio and stills, but very quickly, audio, stills, and full motion.

[49]See Peter Drucker, *Innovation and Entrepreneurship*, Harper and Row, New York, 1985.

Lucky
PCs should have ISDN adapter boards to enable them to be plugged into the ISDN world and to give them access to a broadband bit stream. Such boards exist now, but should become more prevalent in the business environment in the next few years. PCs should also have add-on boards with chips for digital signal processing to provide image and audio manipulation.

Mayer
The concept of where authoring takes place is changing. I would put some level of authoring or re-authoring tool right in the computer.

Gilburne
In order to understand the kinds of products that will drive the changes, I have been traipsing through the media bone shops in Hollywood, Cambridge, and Silicon Valley for four years trying to convince creative people to consider producing content using the new technology. My feeling based on this experience is that there is no way to predict what will drive adoption. It will come only after creative people with their ears to the consuming ground get up to speed with the tools. They will produce the content that sells. I was told that it's crazy for me, coming from the world of technology, to try to do predictions about content. The products that will drive massive adoption are probably something none of us is looking at right now. They are going to come from people in places we cannot even identify.

Seybold
How long will it be before a critical mass of businesses have access to fiber optic communication links?

Lucky
Many large businesses have it right now. Wider communication pipes are becoming increasingly prevalent, either through fiber optics or other means.

Seybold

Are we getting a stratification? Is what is becoming true for large businesses not becoming true for smaller businesses? To achieve broad business-to-business communications, it would seem necessary to have wideband communications for small businesses as well as large.

Lucky

Absolutely right. In most data networking today, communicating between companies is very poor. General Motors, American Express, and most large companies have their own internal networks, which are very dense and well-connected. Yet GM cannot talk to IBM. The fact is there is no telephone book of computers. I don't understand why data networking is so bad, except that no one is responsible for making such a telephone book, and no one is responsible for interconnecting all of the networks. ISDN is not the end-all for a computer network. It is very low-level. But ISDN at least offers hope of interconnection at some level, such as ASCII. ISDN is like many little islands. It's going to be at least six years before the islands start coming together.

Seybold

You have suggested putting ISDN connections into PCs. Will it be six years before we can do inter-company communication using those connections?

Lucky

That's right. A lot of the power of ISDN comes from the so-called D-channel, the sixteen kilobit packet switched channel by which ISDN is accessed and which gives intelligence to a network. The D-channel only goes as far as the central office. You cannot send packets to the other end of the line. They are ripped off at the first central office. The problem is not with the idea of ISDN, but with the way it exists today.

Seybold

How then do you get a business market started?

Lucky

Our strategy at AT&T is always to go to the big companies first. They have the dollars, networks, and super people to do their own network management architecture. Then we descend to smaller businesses, and finally to the home where there are no dollars.

Arnett

One of the business uses of multimedia that I think will be important in the future is in E-mail and in real time. Staring at another person's face does not add much value, but staring at another person's spreadsheet or computer document can be very valuable. I do not want to bring people into my office when they can (and want to) work at home. With products such as Farallon's Timbuktu to do editing between office and home, people do not have to come to the office. Offices could be decentralized the way that whole businesses have been decentralized by telecommunications.

Lucky

I agree. We are working on two applications that I think are valuable, although they are not classic interactive multimedia: (1) multimedia conferencing and (2) document retrieval and browsing. What I'd really like to see are digital libraries on-line and easily browsable, and multimedia conferencing that enables me, as you say, to look at other people's programs, share applications, and discuss things in real time.

Kay

I have a disagreement with Steve Mayer's reference to Marshall McLuhan. When McLuhan said "the medium is the message," he was not making a

statement about the media, but about the receivers of the message. He was making a profound point. The receiver has to internalize the medium in order to strip the message from it. There is no such thing as a medium disappearing, except inside of us. The medium is not neutral at all.[50] Information is not interconvertible between different forms with similar impact. That idea is at odds with everything known about human psychology. The form strongly influences the receiver's reaction, whether it be emotional and spinal or rational and intellectual.

Mayer

What I was arguing is that the people who do the final framing of an end event should have access to all prior information. If, for instance, they want to incorporate a 3-D model, they should have the data used to create the model, and even the intellectual framework behind it. Discarding information along the way would be criminal. The information may not be usable directly, but it should be available for reformatting to match the experience they are trying to create.

Cooper

The application that keeps me interested in multimedia is in my field of marketing. We are now at a point where a marketing manager in a consumer products firm can receive a million new numbers every Monday morning. He has to figure out what to do with these numbers. Unless we can make the numbers meaningful, they may not be used at all, and a real opportunity will have been lost.

In marketing science, we try to accumulate knowledge about markets, competition, and environments to use in planning business activity over the medium and longer term. My own academic work is in high-parameter models. There is no insight to be gained from looking only at the parameters of such models. They have to be embedded in simulators. But even simula-

[50] "The most important thing about any communications medium is that message receipt is really message recovery. . . . [Y]ou have to *become* the medium if you use it." [Alan Kay, in Brenda Laurel, p 192 (See Bibliography)]

tors can be incomprehensible without visualization. People learning about markets and competition in order to run their businesses have to be like authors building knowledge. Developing the kinds of systems that allow this to happen raises the multimedia ante. Perhaps management education, with its focus on business problems, can provide an appropriate crucible for such things to develop.

Minsker

I want to ask Miles Gilburne for examples of what those 20,000 MacroMind developers are doing.

Gilburne

MacroMind has a CD-ROM with many samples of such work. Almost every multimedia show and user group meeting has examples too, particularly of the new 3-D displays. The MacroMind developers are doing everything from interactive training to desktop video to modeling new products — for fees of from $20,000 to $100,000. Their work for the Fortune 500 is in predictable areas of visualization, learning, and presentation. Every time you look you see a new user interface that one of the developers has created, whether a jukebox interface that allows you to click on a title, drop it into a hole, and play it, or a shopping mall interface used to browse through different stores. What I've seen in my travels is not leverageable content that can be sold to a broad group, so much as specific work for specific customers. But the experimentation going on with character animation and interface design should be the basis for putting together more leverageable content over the next few years.

Arnett

I want to bring up the problem of information overload.[51] Multimedia is in danger of becoming part of the problem rather than the solution. I get a ton

[51] "The difficulty seems to be not so much that we publish unduly in view of the extent and variety of present-day interests, but rather that publication has extended far beyond our present ability to make real use of the record." [Vannevar Bush, "As We May Think," *Atlantic Monthly*, 176, 101-108, July 1945.] Vannevar Bush's commentary on information overload in 1945 is even more true today!

of paper every day. An awful lot of things are on paper. Electronic libraries are a great idea, but just think about the amount of data in a library. The sheer work — even using optical character recognition and advanced tools — to get the contents of one public library into digital form is outrageous. It isn't going to happen for decades.[52]

There's a misconception that multimedia does it all. Now that we have motion, sound, icons, and mice, we can supposedly do anything. But we can't.

Computer systems need to manage information they do not themselves contain or have available on-line. Apple's video on the Knowledge Navigator shows a computer that knows what databases to search. When I look up a topic in my on-line *Grolier's Encyclopedia*, I would like the system to tell me the books in the local library on that subject. Every book and piece of software I buy for my business has a universal price code marked on it. Why can't I use a bar code reader to scan such codes into the computer and build a personal index of what's on my bookshelf? If we put a bar code onto all the paper that comes through our office — an incredible stack of mail — then, by scanning, we could build a personal index. There might be a business in that kind of service.

Lucky

And you're worried about information overload? The problem is not in storing the information. It is in ever finding it again.

Arnett

That's what I mean. What I want is for the computer to help me navigate to the information that stays on paper. I don't want press releases stored on my

[52] In 1961, Dartmouth professor John G. Kemeny, who later coauthored the Basic programming language and still later became president of Dartmouth, projected an automated national library to replace that of the university, which he felt would be obsolete by the year 2000. The university library has proven much more resilient than Kemeny expected, and the automated library much more elusive. [J. G. Kemeny, "A Library for 2000 A.D.," in Greenberger, *Computers and the World of the Future* (See Bibliography)]

computer. I just want the index information that helps me find those press releases.

Robert Abel's *Guernica* is one of the best multimedia exhibits currently available.[53] It should suggest related books or videotapes to which I can refer. That is why California has undertaken the *Science 2000* project to which Apple and IBM are both contributing. The project uses HyperCard and Linkway to provide interactive multimedia, but also tells the teacher what books, film strips, and videos are available at school, district and state levels. That is how I want my business information systems to work. If all we do is come up with new information, we will be contributing to the overload problem instead of helping to solve it.

Kay

Do the arithmetic for the Santa Monica Public Library, which is not small, but neither is it the size of UCLA's. Thirty of Toshiba's PC-based optical character recognition products, which parse the page and can recognize fine text and identify columns, could put the entire Santa Monica Public Library on-line in less than a year-and-a-half.

Arnett

The libraries are having trouble staying open eight hours a day. Sure, the technology's there. It could be done. But the libraries and schools cannot afford to do it.

Kay

Dartmouth did a study toward the end of the 1960s showing it would have to charge $55 every time somebody took out a book if it were to bill users of its library (including residents of the town of Hanover, New Hampshire) by

[53] Abel's *Guernica* is based on the famous painting by Pablo Picasso. Guernica, a town in north-central Spain, was destroyed in 1937 during the Spanish Civil War by German and Italian aircraft in the first mass bombing of an urban community.

transaction. Instead, it amortized the costs on the basis of its library's adding value to the community. It also let everybody in the town have free time on its time-sharing system. Amortizing costs leads to much higher levels of use than does charging for transactions.

The same thing is true in thinking about digitizing a library. It would be value added to a community. The arithmetic is then not excessive. Somebody just has to decide to do it.

Arnett

Even if I'm prepared to believe that, how do you put the information into a form where people can locate what they want? The military is finding that the tons of paper on an aircraft carrier are affecting the handling of the ship. The admiral says, "Can you throw it at the enemy? No? Then get it off the ship. Put it on disk." But you can't just put it on disk.

Kay

I didn't say say put it on disk. That would be terrible.

Arnett

Then what do you do with it? How do you put it in the computer so that it's useful?

Kay

The first thing to realize is that libraries are useful right now. That's an astounding idea, I know. Still, we can do much better. I would be more optimistic, if I were you.

Seybold

Because card filing systems did not work well, we've been putting library catalogues on computers since the 1960s.[54] The problem has not been know-

[54] OCLC, started in the 1960s in Columbus, Ohio, today provides on-line card catalogue services for virtually every major university library.

ing how to use a computer to find books. It has been converting the text into digital form. I think conversion would take longer than Alan suggests, but I agree it's still manageable. The problem is that for most people text in a computer is much less useful than text in a book.

Lucky

I don't know how many times a library search of abstracts has drawn my attention to a paper that looked good, only to find after going to a lot of trouble to get the paper that it's junk. Nothing substitutes for actually seeing the paper with one's own high-level pattern recognition faculties. In any electronic system, I want a facsimile of the paper to browse through.

I have a friend who is trying to make digital libraries. He uses a paradigm of walking down the shelves electronically, pulling books out by the spine, and opening them up randomly — just the kind of browsing we do at a library. He conducted a trial. Nobody used his digital library. It was too small. If a library has certain bounds outside of which you cannot go, people will not want to use it. My friend had two choices. He could either expand what he had done to the whole library and take on the job of digitizing it all, or he could find a subject that was so arcane that the body of material on it would be small.

He chose the latter option. He found this worm called *c. elegans* with which he felt no one was concerned. The worm is about an eighth of an inch long and seems to serve no purpose in life. He tried to find all the information he could about this worm. The results, by a benchmark I like to use, are interesting. How much is known about this worm in terms of information transmitted along an optical fiber? If you think of an optical fiber as transmitting roughly a gigabit a second (one billion bits per second), how long does it take to send one worm? Surprisingly, it takes fifteen minutes: fifteen minutes at our highest speed of communication.

The moral is, when you delve into anything deeply, you uncover a lot of information.

Kay

That's the animal they use in embryology. It's the one animal for which they know the fate of every cell. They know a lot about that worm.

Lucky

More than the worm knows about itself. They have every cell micrographed at high resolution.

Lanham

If you want to know about the economics of digitizing libraries, a great deal of thinking has been done by the national effort to preserve books from acid paper decay.[55] I think the findings would preempt most of the discussion on the subject here. It turns out that digitization is neither feasible for the whole library world nor advisable.

I have been sitting here feeling more and more strange, as if I were the humanist bastard at a scientific family reunion. Many of the issues discussed, such as the self-consciousness that interactivity elicits, have a rich intellectual history. The oscillation between looking at and looking through a stylistic or expressive surface, for example, is part-and-parcel of any kind of interactive game or artistic process, including reading, listening to music, and looking at pictures. Such issues have been discussed over and over again in detail in the literature on post-modern thinking in the arts and letters. There is a great deal of wisdom in this literature.

Likewise, the process and product, or content and shell argument brought up here repeatedly is a commonplace in current discussions in the arts and letters. There is really no need, in this respect, to reinvent the wheel. The whole question of literacy, which has emerged again and again here, has an ancient heritage in basic discussions of orality in classical Greece. This commentary could define and control the discussion here in very desirable

[55] Techniques for preserving books include microfilm and microfiche, as well as digitizing.

ways. And the whole question surrounding the mixture of images, music, and words has been discussed repeatedly under the general rubric of *Gesamptkunstwerk* from Wagner onward. It was at the center of the profound theoretical speculations of John Cage.[56] Finally, the relationship between art and science or art and technology which has danced through this discussion also has been debated repeatedly in other venues.

Lucky

Perhaps you could supply us with a reading list.[57] I don't think we realized all these problems had been solved.

Lanham

I'm not saying they have been solved, but certainly they have been defined to a reasonable degree and are worth thinking about in those terms. I thought a comment like this might be in order in the spirit of Martin Greenberger's intent for this meeting to be a place where people meet who do not customarily come together. I, at least, don't generally meet with these kinds of people. If my comment is out of order, I certainly will not be invited again.

Lucky

You find us surprisingly naive, perhaps?

[56] Lanham adds, "I'd recommend you read Cage. He's a very interesting kind of manager, anticipating, among other things, chaos theory." For an introduction to modern experimental music, see Michael Nyman's *Experimental Music: Cage and Beyond*. "It provides an interesting entry point to the study of how music is currently being transformed by digitization."

[57] Lanham later complied by sending three of his essays, a reading list, and a letter dated 4/20/90 to several participants who had expressed interest. The three essays, *The Electronic Word*, *The Extraordinary Convergence*, and *Digital Decorum*, explore an area Lanham spoke of at the Roundtable: "The relationship between computer aesthetics and ethics and the more traditional discussion of those two subjects in Western culture." On the convergence of computer aesthetics and postmodern art, he recommends starting with three volumes in the Oxford University Press series *The World of Art*: Lucy R. Lippard, *Pop Art;* Hans Richter, *Dada: Art and Anti-Art;* and Caroline Tisdall and Angelo Bozzolla, *Futurism*. For an initial discussion of how electronic information undermines the basis of copyright law, Lanham suggests reading Ithiel de Sola Pool, *Technologies of Freedom*. He also mentions Ethan Katsh, *The Electronic Media and the Transformation of Law*, on the implications of electronic text for the law. According to Lanham, the Italian Futurists seem to have anticipated much of what electronic text is doing today. The Dada movement started the deep questioning of authoritative text which the computer has now brought to maturity. And the Pop and Op artists explored the fundamental changes in scaling and in the alphabet/icon ratio for information which the computer has so reinforced today.

Lanham
Well, the whole question of the relationship of images and music and words has been considered repeatedly. I guess I do find some of the discussion naive.

Winter
But disarmingly so.

Lanham
Yes, disarmingly so, and charmingly.

Lucky
Thanks. Do you know anything about computers?

Lanham
I'm trying to learn! I find it amazing how digital expression, in fact, fulfills a number of strands of modern thought. The convergence is extraordinary. But I don't see how we're going to comprehend that convergence unless we can come to understand the body of thinking which underpins it.

Kay
I don't think we have to understand it all that much. Some of us have read in many of the areas you mentioned, and it is valuable. But just because people have sat around and deliberated something, even if they were very smart, is no reason to assume we can learn from them.

I have a morgue of famous last words by famous groups of people. One of my favorites is by Lord Haldane and the British Ministry of War who declared in 1907 that the heavier-than-air plane would never fly. This was four years after it had flown. I believe it is a mistake to draw conclusions from the fact that people have talked about things for a long time. What is

important is to keep talking. Just because people have discussed things in the past does not mean they've settled any issues.

Lanham

No, no. I didn't want to shut down discussion. I was just suggesting how it might be enriched.

Kay

Well, I think history does enrich, but I don't think it necessarily informs. I'm basically a classicist by background. My father was a product of the British classical education system. I grew up with its particular way of looking at things. I found this orientation somewhat useful, but not of paramount importance in coming up with new ideas.

It *is* silly to reinvent the wheel. You usually get something with bumps on it. On the other hand, the opinions of cave men on whether there could be a wheel or not were fairly irrelevant before the wheel was invented. The point is, to the extent what we are doing resembles something invented in the past, the past is useful. To the extent it does not, the past is largely irrelevant.

The most important thing about the computer is the way it adds dimensions. If I take a card in two dimensions and put a pair of dots on it, I've generated distance. That's something we all accept. But with one more dimension, I can collapse the distance between the dots by folding the paper so the dots overlap. The computer, unlike anything we've had before, can always give us more dimensions. There's nothing written by any Greek scholar about that.

The key to multimedia is not the media part, but what *multi* really means. To me, it doesn't mean lots of media. It means lots of dimensions. What we should be talking about are the dimensions the computer provides that no other physical entity can have.

Lanham

I was not trying to diminish the value of the computer. I am as much an admirer of it as anyone, though not so learned a one as many around this table. What I think is missing in discussions of this sort is an awareness that there is an historical aspect to these problems and an acknowledgement that it should be consulted. You seem to be saying that we really do not need to bother about the historical aspect.

Kay

I didn't say that. I said something much more important. I said it has been consulted by some of us and has not proven to be that useful. The first question you might have asked is, "Has anybody consulted the historical aspect?"

Lanham

I was just going by what you said and the tenor of your comments.

Kay

I only had seven minutes!

Cooper

There is a tension between the two positions represented here that reminds me of a book I read in 1957 by the eminent British biologist, W. I. B. Beveridge. One of the positions in the book emphasized the importance of understanding historic debate and prior knowledge. The other position, in extreme form, was that prior knowledge blocked creative thought. I remember putting the book down after reading this idea on page 2 or 3, and deciding then and there I would be a scientist.[58]

[58] W.I.B. Beveridge, *The Art of Scientific Investigation*, rev. ed. New York: W.W. Norton & Company, 1957. Some quotes from the book give its flavor: "I had an immense advantage . . . inasmuch as I had no fixed ideas derived from long established practice . . . and did not suffer from the general belief that whatever is, is right." [Bessemer, discoverer of the process for producing cheap steel] "It is that which we *do* know which is the great hindrance to our learning, not that which we do *not* know." [Claude Bernard, French physiologist] "Reading rots the mind." [George Bernard Shaw] "To be perfectly original one should think much and read little [yet] one must have read before one has learnt to think." [Byron]

Abel

Even though we've bandied this word multimedia about for several years, I think Alan Kay's interpretation of *multi* is right on. I ask myself, what can I do with this medium that I can't do any other way? It's more than combining the separate media. There's a whole that's greater than the sum of its parts.

I want to ask Robert Lucky a question. Maybe I've been wasting all my time, but I've been very image-driven. You seemed to imply that sound and text were more important than pictures.

Lucky

For information.

Abel

I take exception, but let me acknowledge that Bell Labs has been of great help to me. When I first started with computer graphics, I ran into a lot of technocracy, except at Bell Labs. There people said, what do you want to do? I told them I wanted to use images to make the invisible visible. They gave a lot of background to the work I did. There were certain kinds of images I couldn't photograph or explain with words or sound. It was possible only with computer graphics.

Bell Labs has done a great deal with the power of the image. Steven Mayer referred earlier to cave paintings. 40,000 years ago a painting on a wall would cause cave men to go out and hunt a saber-tooth tiger with a club. There must have been a lot of power in those images.

People used to say, "One picture's worth a thousand words. If you can make it move, it's worth a million." Disney proved that many times over. When I was working for Charles Eames in the 1960s, we learned from the UCLA psychology department that people could gain information between ten and a hundred times faster than normal by looking at images rather than hearing

sound. My two children have grown up on MTV. I'm not ready to take images out of my vocabulary.

Stulberg

For four years, Professor Negroponte notwithstanding, we have worked our heads off at my company dealing with the issues of interactive media. We were glad to hear John Sculley say he prefers the term interactive media to multimedia. It's no coincidence that we decided to use that phrase in naming our company.

My concern today, with all due deference to the extraordinary intellectual capacities, abilities, and backgrounds of the people here, is that we have not begun to deal with the critical issue: who are the ultimate recipients of the interactive multimedia experience? What are their profiles? What do they really want?

I am very much in accord with Richard Lanham in this respect. One thing we have found in our four years of experience is that creeping functionalism takes over once interactive multimedia is let loose on the people who have been thirsting for it. Designers are so enamored of the capacity of the technology, they lose all sense of what they should put on the disc. They lose sight of what the ultimate user wants to have.

We have quietly worked in the vineyard for four years and have been damned and degraded and told we're out of business by more than one competing technology and academic institution. Yet, in twelve months, we are going to introduce a player for under $1,000 and thirty titles that we hope will make people understand that interactive multimedia appealing to the emotions and needs of users is here now, not three, five, or ten years away. The fact that we have labored quietly and away from conferences, discussions, and presentations does not mean it doesn't exist. It does. The environment and tools are here.

What we need in the next conference, Martin, is to meld this group with the young computer scientists and interactive designers who have been attracted to the field. You should see them! They come in the door and say, "I've been waiting for this. I have a dream about how to use audio, video, graphics, animation and full-screen, full-motion video. I want to use it to create emotion and response." The brilliant young men and women who want to design for the technology are the people I'd like to see sitting with this group.

Glaser

It sounds like what you are calling for is a CD-I developers' conference.

Stulberg

I have not commented upon Microsoft or anything you do. I think it's unfair, unkind, and inappropriate for you or Mr. Negroponte to make comments about CD-I.

Glaser

I was trying to paraphrase what I thought you were saying. One of the reasons this has been such a chaotic session is we don't have a common vernacular. As much as I would love this to be a session on the new Windows multimedia PC, or on how to bring multimedia into the PC world, I've tried to restrain myself. It's clear that most of us don't even agree on whether to call our subject intermedia or new media or multimedia, or whether that means touch or animation or a computer that talks back at you, or DVI, or CD-ROM, or laserdisc. Frankly I welcome the chaos, because it creates a hot-bed of ideas. I did not come to this meeting to learn the five best applications for the multimedia PC we're trying to help catalyze, or its proper price point, or whether to sell it at K-Mart. There is value in the diversity here. I would urge you to feel good about the fact that we're not all agreeing. I do. I came here to learn, and to contribute a tiny bit. I will view this as a successful event if we begin the kind of discussion that does not happen in multilateral ways very often.

Stein

This is finally beginning to get interesting. I haven't been this disturbed in a long time. Obviously we disagree. That's okay. But people here are so disparate that the wrong people are agreeing and disagreeing. I find it absurd that Gordon Stulberg should be defending Dick Lanham, whom Alan Kay is attacking. Most of you do not know Dick. I don't think you heard what he said correctly.

When I was at Atari with Alan Kay, there was a tremendous amount of excitement about the technology, but not much real excitement about the content. Very little of what happened had to do with the communication of ideas. In the last year or so, the tools and hardware platforms have gotten good enough so people with something to say are now starting to do interesting work.

At Atari, we tried to raise the level of understanding of the people who came out of Nicholas Negroponte's lab, and teach them something about science, history, and art. It's ridiculous for Gordon Stulberg to be defending that position. All of his company's work for the past four years has centered on how neat the technology is, not about the importance of the content.

There have been two really seminal papers for me in the last ten years. One was by Nicholas Negroponte on the movie manual and other things they did at MIT. Ten years later, I've gotten equally excited about Dick Lanham's writing on what is going to happen to literature as it comes to the digital world. Lanham has several Macintoshes on his desk. He knows a lot about computers. I think all he's saying to us is that there have been interesting things considered in the last hundred years. Read about it. It might help inform some of what you're about to do. I don't really think there's any argument with that.

Kay

I don't disagree with it.

Stein
I know you don't.

Kay
I knew I wasn't disagreeing with it. I was just disagreeing with the tone of it. I said what I said very carefully.

■ Quinlan
Multimedia is being exploited differently in the business world than in the home and in education. The business world is where I spend my time. I've been in marketing with IBM as president of the National Accounts Division, and am very familiar with the Fortune 500 companies. They're further along than home and education because of the luxuries they have that do not exist in the other arenas. They don't have to provide global solutions. They can get pragmatic and define their world the way they want (an educator can't). They tend to own their data (no copyright problems). And their budgets allow them to get started *now*.

The business world is applying multimedia in three broad areas: training, merchandising, and what I'll call operational solutions. I'll start with training as an example. The educational problem in manufacturing is to train workers so they can use the latest tools. This will have to be done again in two years as tools change and workers become obsolete. It's a very primitive need for education. It contrasts with the elegant concepts of *Ulysses* and the other demonstrations we've seen here.

I'm not complaining. Teachers ought to have a more elegant view of how to communicate. I would like my children to be influenced by such views. But if I'm running a manufacturing plant, I can do with less elegance. I want to train people now. Since one third of them can't read, multimedia will help. I can prove that it's cost-justified with today's technology.

(Quinlan)
The first order of business is to get player systems that are affordable. Authoring systems are not the issue. Once there are enough player systems out there, people will use their creativity to develop authoring systems and will pay a good price for them.

You can't go into an airline reservation office today and not be attracted by what is being offered to you as a consumer. The airlines are not doing this because they care about you *per se*. They do, but they're competing for the airline reservation seats, so to speak. They'll spend tons of money right now to provide the most exciting, impact-oriented multimedia presentations in order to occupy a desktop. If one airline does not occupy it, another airline will. This provides a different orientation.

In this calendar year, some major insurance companies will use multimedia to run their business. When you look at how claims are adjusted in the field today, there's normally a "clip" level beyond which you have to go back to headquarters for authorization. Otherwise you do it in the field. In this calendar year, the best insurance companies will have locations, pictures, and voice-annotated messages from the field transmitted back to headquarters so they can run their businesses better. It's happening right now.

Merchandising, which is probably the most mature area, is the most intriguing to me. It introduces an element we haven't discussed yet. Touch generally comes into play with merchandising. This gives me a basis for talking about multimedia a little differently than previous speakers.

I don't like the term *multimedia* either, but I haven't got a better one. What amazes me is how much excitement has been generated in the marketplace with the integration of voice and visualization — effects that appeal to only two senses. I contend that multimedia properly defined is really *sensory computing*.

As we learn to touch, write, and communicate naturally, we'll have a breakthrough that will make this industry stand up and take notice. I believe Fortune 500 companies are already moving in this direction. The technology is affordable. Companies are finally understanding in a very limited, pragmatic sense what this multimedia phenomenon can do. They're not global thinkers. They're bottom-line oriented. They're spending money right now. There's just a different orientation.

Charles Firestone, Moderator
Reese Jones
Louis Petrich
David Nimmer

Innovative ideas and high quality content are vital to the future of multimedia. How are they best promoted and protected? Traditional copyright, outdated and inadequate to the task, often seems more of a hindrance than a help. Yet it is considered the best means available for ensuring authors fair remuneration.[59] *In this session, moderator Charles Firestone and fellow lawyers Louis Petrich and David Nimmer give a structured presentation of copyright law under stress from the new technologies. Computer innovator Reese Jones, calling himself the "token non-lawyer" on the panel, provides a technological backdrop for the discussion. Recounting the problems his company has had in getting rights to images, Jones proposes that sound and video material be routinely encoded with copyright information, a suggestion Max Whitby strongly endorses. David Nimmer, looking for ways of making multimedia possible within existing copyright law, proposes the use of the compulsory license as a vehicle for accommodating all interests. Nimmer further recommends collective bargaining among user and owner groups. A version of this guild practice of the Middle Ages is already used extensively by composers.*

[59] "Some say technology will make copyright obsolete. I disagree. Some specifics of copyright law may need to change, but the basic principles of copyright — the dignity of creations of the intellect and the encouragement of creative effort through economic reward — must be retained." [Jon Baumgarten in Greenberger, *Electronic Publishing Plus*, p. 215]

■ Firestone

In the computer age, information has become an important commodity. A paradigm shift may already be underway. We need to review how society has tended to treat knowledge, invention, and artistic expression in the past. The Constitution encourages creativity in the progress of science and the useful arts through the patent and copyright clauses.[60] Yet, the First Amendment, with its guarantees of freedom of speech and of the press, is often viewed as pushing in the opposite direction.[61] From these legal constructs comes a tension between protecting expression and gaining access to information — a tension both exacerbated and redefined by the new technologies.

Reese Jones will begin the discussion by describing some of the problems facing users of new technologies. Louis Petrich will then outline the copyright laws, after which David Nimmer will go into the compulsory license provisions of copyright, which might contribute to a solution. We will then have a general discussion.

■ Jones

As the token non-lawyer on this panel, I'm asked to represent the point of view of all those creating, re-purposing, or editing content. At Farallon, we're in the business of personal communications and telephone front ends for ISDN, videophones, and the like. As such, we're at the intersection between personal and multipersonal use. We're also a software developer, publisher, and applications provider. Copyright and patent issues can

[60] "The Congress shall have Power . . . To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors exclusive Right to their respective Writings and Discoveries." [U.S. Constitution, article I, section 8]

[61] One man's view: "Some claim that copyright is in opposition to cherished First Amendment values, saying it restricts the public's use of important intellectual achievements. This is a false antagonism. Copyright plays a positive role in fostering the free democratic marketplace of ideas sought by the First Amendment by assuring the creation and dissemination of works of the intellect. Freedom of expression is meaningless unless works are created and distributed." [Baumgarten in Greenberger, *Electronic Publishing Plus*, p. 214]

become quite a problem for us. They pose a major potential impediment to the future development of multimedia.

Fair use allows the individual to make a copy of a videotape or audio disc for personal use. But if you give the disc to your mother, you are in violation of copyright. In a business setting, if you give the copy to an associate or someone outside the company, that's even worse.

Modern telecommunications makes it almost trivial to send someone a piece of video or audio, or a picture from an unknown source, so the chances of making a mistake are very high. Litigation occurs only if the transaction is above a certain threshold. The gray area is probably for applications of up to $100,000 in production costs. Unfortunately, this is the range in which most multimedia applications lie.

Jack Sculley mentioned the trouble he has had in first finding suitable content, then obtaining the rights to use it. The most accessible content resides in the music and video stores, or comes to us by satellite and cable TV. This content is the easiest to obtain and the most perilous to use.

A related problem of proprietorship has to do with the compressing, storing, and decompressing of digital data. Nicholas Negroponte made the point that in an object-oriented model, the computer should be able to interpret any format presented and adapt it for use in an editing or viewing environment. The implication is that the standard in which data is encoded — be it CD-I, DVI, or whatever — is irrelevant.

Though this may be technically feasible, it would not be legal. Consider data encoded in either an I-386-readable format, a Macintosh-readable format, or a format produced with a DVI proprietary compression algorithm. If decoding the data and adapting it to a viewer's purpose required reverse engineering without benefit of a license, it would probably be in violation of

(Jones)
either a patent, copyright, or possibly a trade secret. Even though it's technically possible, it may not be legally permissible.

So if you are a content provider who wants to publish information, you have a problem in the format you select on disc or in how you broadcast over the ISDN. If you choose to broadcast in a proprietary compressed format, otherwise known as a legally encrypted format, the receiver of the signal will have to pay the company that defined the algorithm to hear or see what you sent.

The CD-ROM XA format provides an example of where this problem can cause a failure in the marketplace. Even though the compressed audio standard within CD-ROM XA has been well-defined for some time, and even though Sony has provided chip sets and development systems to author in the CD-ROM XA format, to my knowledge there are no commercial discs shipping. Buyers of the discs are not likely to have the necessary proprietary decompression chips on their machines. Unless these chips become almost free (Sony could make them free), authors are taking too great a risk encoding their data in the CD-ROM XA format.

The same thing is about to happen with video compression, where there's DVI, MPEG, JPEG, Px 64 and a variety of different algorithms, some of them proprietary, some in the public domain. An owner of video material wanting to publish a disc will not opt for a compression algorithm that is unreadable by most players. Publishers like Robert Stein at the Voyager Company prefer to distribute material using the non-compressed public domain standards of the laserdisc and CD-DA. It's better from their point of view to settle for lower quality, less material, or higher cost than to encode in a proprietary format.

Another critical problem area — a new one — has to do with software patents. Software and software algorithms have just recently become patentable. This can be terrifying for someone in the business of writing and publishing software.

The way software patents work is: you develop a particular algorithm, then go through a three-to-seven-year process of filing with the patent office, during which time the technique becomes standard practice. By the time the patent issues, the technique may have been adopted by many programs in the marketplace.

An example is the basic way a spreadsheet calculates a row of numbers. This is a patented technique. The patent was filed back in the early 1980s. Even though it seems an obvious procedure today, at the time the patent was filed, it might legitimately have seemed unobvious. After filing, the patent was more or less overlooked. The author did not seem to care that much about it. But a speculator took the case on contingency to litigate with Lotus. The cost of defending the case, even if the patent is proven invalid, may be well in excess of $100,000.

This is just one algorithm or process of the thousands that go into making a commercial software product like a spreadsheet. That translates into thousands of possible liability points that could potentially crop up in coming years — not a pleasant prospect for Lotus. The holder of a patent is unlikely to say, "You've got to stop selling those spreadsheets." Settling in court for a royalty of 30 to 33 percent of the retail price of the commercial product is standard in the industry. For Lotus 1-2-3, that means $150 for adding a column of numbers — one process out of thousands in the product. With the second patented process, and the third — you begin to see the problem.

An example of relevance to multimedia is a 1979 patent filed for an interactive teaching machine consisting of a VCR, a TV, and some buttons numbered 1, 2, 3, or 4. The machine presents the user with a scenario and asks, "What do you think will happen? Choose 1, 2, 3 or 4." Then it plays a response back from among the four alternatives. This may seem obvious, but it's patented. If the patent were sold to a speculator and the speculator came to sue, it would cost at least $150,000 for something done in almost every interactive application. This is but one of the patents coming out in this area.

(Jones)
Another example of relevance in this setting is copyright applied to anthologies, such as the anthology of public-domain software that has been uploaded onto a CompuServe bulletin board. CompuServe has no intellectual property rights to any individual piece of the anthology, but it does have rights to the totality. Delphi, a competitor to CompuServe, wanted to have an anthology of public domain software on its system. As soon as it started putting together the anthology, CompuServe sued, claiming Delphi was copying the public domain software (that neither owned) from CompuServe's system to put on its own system. CompuServe won, forcing Delphi to get separately identified authorization from each author of each public domain software product in order to upload it onto its system.

I was directly involved in a very similar situation. BMUG, the Berkeley Macintosh User's Group, took on a CD-ROM project to bring together an anthology of all public domain software for the Macintosh. Since, for liability reasons, we could not take the anthology from any of the on-line services, or even from the private bulletin boards, an army of people had to contact each individual author of each public domain software product, on the phone or by E-Mail, to obtain written authorization for it to be distributed in another anthology. There are possibly 10,000 software programs in this anthology. The source of each one had to be identified. When there was no way of knowing where the software came from or who wrote it, it was assumed to be outside the public domain and was not included.

Similarly, pieces of sound and video that do not have standard file formats or headers showing the copyright or creator provide no way to track potential violations. Under these circumstances, a commercial company, not knowing its exposure, cannot use the material — which is very limiting. We are in favor of people working together to standardize a file format that includes header and copyright. Then, if something is copied out and pasted somewhere else, the copyright information goes with it.

Let me relate a final story of a problem we had at Farallon in obtaining a license for a single image (Robert Abel's *Guernica* must contain 10,000 to 20,000 images) — a picture of Albert Einstein. We obtained the license from what we thought was a proper house in New York for clearing and licensing photographs. We had been running the photograph publicly for several months when we got a phone call from the Einstein estate claiming we owed it a royalty. We protested that we had licensed the photograph from a clearing house in New York, and gave the number, to which the woman on the other end replied, "Oh, those guys again." Here we had paid good money to properly license the photograph, or so we thought, and it turned out that we were still completely liable to the people who had the legitimate rights. The chances of getting our money back from the illegitimate licensors were not worth the legal fees.

Whitby

I very much support the idea of developing early on a way of encoding information on copyright, source, the volume from which the material came, some physical description of it, what it means, and the key words that go with it. Such information could support search engines at a later time. The format should be designed to be as extensible and flexible as possible. Then, content and tools could be compatible. An editor would be able to open and use a piece of content published today in a multimedia format at any future time.

■ Petrich

I will give a brief overview of the likely impact of copyright laws, covering first, how to use protected works in multimedia without incurring legal liability, and second, how to protect new works created as compilations or adaptations of prior works.

(Petrich)

My opening observation is that just as the military is accused of planning how to win the last war, copyright laws in the last 200 years have been designed around how to resolve past disputes involving established technology. The law and its makers do not tend to look forward to new technology. Congress usually does not react until a problem has become so intense that the pressure from lobbyists in Washington gets it moving. The last revision to copyright came in 1976 from a big push starting in 1955. The main impetus was the battle over compulsory licensing for cable systems.[62] The political fighting was tremendous.

Congress traditionally does not act until all concerned parties — the users, the owners, and so on — have made a deal which they bring to it. Then Congress will act. That's probably what we can expect in multimedia. In general, I think existing laws will make use of protected material expensive and complicated.

To set the context, let me review some of the basic rules. First, copyright protects only original works of authorship. A work does not have to be novel or unique — just original in the sense that the author originated it himself and did not copy it from another source.[63] Thus, a new collection or anthology of public domain works qualifies, as does a new version of Shakespeare, a new arrangement of music, or a new compilation of prose. But the protection may be very thin if what is new and original is simply the way the old materials have been arranged. Someone else, not infringing upon the arrangement as such, can legally use its public domain parts.

Copyright protects the author's expression, not the ideas, concepts, facts, processes, procedures, principles, or discoveries in a work.[64] The problem in

[62] See Title 17 United States Code, Section 111 (Abbreviated 17 U.S.C. § 111 and available at any law library)

[63] 17 U.S.C. § 102 ("Copyright protection subsists . . . in original works of authorship"). See also, 1 M. & D. Nimmer, *Nimmer on Copyright* § 2.01 (1989) ("Nimmer" hereafter)

[64] 17 U.S.C. § 102 (b); 1 *Nimmer* §§ 2.03, 2.11

copyright is deciding the difference between idea and expression. That's where most litigation occurs.

A work is protected just as soon as it is put in a tangible medium of expression which can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device. It is not necessary that a copyright notice be placed on the material, or that it be registered. People in the motion picture and entertainment business, where I mostly work, get into trouble because they assume that since something is not registered it can be used. That isn't so. Under our copyright laws, the material is copyrighted the minute it is written down, so long as it is original.[65]

Not all uses are protected by copyright law, only very specific uses. The author or owner is given five rights: the right to (1) reproduce copies; (2) prepare derivative works or adaptations of the original work; (3) distribute copies by sale, rental, or lease; (4) publicly perform certain kinds of works, such as literary, dramatic, or choreographic works, by either standing up and, for example, singing a song, or by transmitting the work over radio or television; (5) publicly display certain works, such as art.[66]

How do you create a multimedia program without liability? Assume the program includes a new compilation of prior works, including factual biographies and histories, dramatic material, fictional works, novels, music and other sounds, video, movies, photographs, and drawings. The first question is, does inclusion of an unlicensed work in the program constitute infringement? For literary works, the answer is yes, unless it is something obviously not protected, such as facts, statistics, or history, or unless it is a *de minimus* use — a few words, maybe a sentence or two.[67]

[65] 17 U.S.C. § 102 (a); 1 *Nimmer* §§ 2.03 [B]

[66] 17 U.S.C. § 106

[67] See 3 *Nimmer* § 13.03 [A] at 13-42 to -43

(Petrich)

Unauthorized use of material will not be prohibited if viewed as *fair use*. Other than that, with any kind of commercial use, the copyright laws tend to be very proprietary in nature and protective of the author.

Determining if something is *fair use* may depend on whether the new use is competitive with the original work. Transferring to disc something taken from a motion picture may not be a fair use, inasmuch as the creator of the original work has the right to license new derivative works. You've infringed if you're making commercial use of a derivative work without a license.

The First Amendment does not offer much of a defense, since courts have been slow to recognize that free speech has anything to do with copyright. They point out that ideas can be used even though expression cannot. They also contend that free speech interests are already balanced in the *fair use* doctrine, which is not true. In the application of *fair use*, proprietary interests tend to far outweigh public interests, although in a few cases free speech has taken precedence over the proprietary interests of copyright.

One example was the question of whether to allow use of the actual photographs of the Kennedy assassination from the Zapruder film. After lengthy debate, use was permitted based on the historical significance of the event.[68]

A current hot topic has to do with the use of diaries and unpublished material of people such as L. Ron Hubbard. Someone did a biography about Hubbard and tried to use bits and pieces from the tremendous amount of unpublished material that exists on him. They were enjoined. The case has gone up and down the New York courts several times. One judge tried to argue that since the biographical book's intent was to make an instructive point rather than enliven the new work, it was a *fair use*. The appellate courts are not buying that distinction.

[68] Time, Inc. v. Bernard Geis Assocs., 293 F Supp. 130 (S.D.N.Y. 1968)

I think what you're going to end up with in most of these situations is either a license or individual negotiation with the owners, usually publishers. You are still going to have a problem if it's not just the right to use you want but the right to create a new work. This makes publishers very nervous. They typically want to put tremendous limitations on a new work. If you are making a movie, they may want to see the script first to see how the book is going to be used. Then you have the additional problem of other people revising or otherwise using your new work, creating more new works, and on and on.

Another possible approach, although not an alternative to licensing, is insurance. Nothing goes on television today that is not insured. The insurance is there primarily to pay for defense costs. The experience in the motion picture industry is that 85 to 90 percent of the cost goes to defense, not to the payment of judgments. This has had two effects. First, it has allowed business operations to proceed without fear of shutting down, so that, in the motion picture and dramatic areas, things have been loosened up for the creators and users of dramatic material. Second, it has created a defense copyright bar that has had an impact on the development of copyright law.[69]

In music, copyright affects two distinct types of works. First is the musical composition itself — the lyrics and the music — which are protected against copying, adaptation, distribution, and public performance. Individual publishers give licenses for copies and adaptations, and publishing societies license public performances for radio and television. In multimedia, synchronizing music with motion pictures also may require a license, as it does in motion pictures, where a separate license called the *synch license* has to be paid for along with the license for publicly performing the movie or making mechanical copies of a videocassette of the movie. The Harry Fox Agency acts as a clearing house for these licenses.

[69] E.g., before 1981, not a single reported decision of the Ninth Circuit Court of Appeals (reviewing the federal trial court decisions of the Western states) upheld summary decisions for defendants on grounds that the material allegedly copied by alleged infringers was copied at such an abstract level as to be non-infringing. Now such decisions are routine, thus reducing the threat of frivolous litigation.

(Petrich)

The other kind of musical work is the sound recording. To copy from a Madonna album, you have to deal not only with the publisher of the music and lyrics, but also the producer of the recorded vocal, instrumental, and sound effects. Copyright law gives limited protection against duplication or adaptation of the sounds, including rearrangement, remixing, or alteration of the sequence or quality in a new work. It does not protect against imitation or simulation, although a sound-alike Madonna rendition may present problems under trademark laws. Licensing is accomplished through individual negotiation, which is expensive and time consuming. The same sorts of problems occur in the use of graphic works, photos, and film adaptations.

Having created a new work, assuming licenses have been obtained, how is it protected? If it is fixed in a tangible medium of expression, like a disc, and if it's machine-readable, then it is protected. If it's derivative, you must have the consent of the owners of the underlying material. You cannot register for copyright if your work is derived from another work and you do not have the consent of the underlying owner.

What does the new copyright provide? It only protects what you have brought to the work that is new. This may be completely new material, literary or otherwise, or just a new arrangement or selection, such as the kind of anthology to which Reese Jones referred. For new works after March 1, 1989, copyright notices are optional, although there are advantages to adding them.[70] Registration and deposit of the new work are also optional, unless you want to sue for infringement. You can delay until the time comes to sue, although you may lose the right to obtain attorneys' fees in the action if you wait.

Who is the owner of these new works? Typically, the author is easy to determine, unless there is joint authorship, or contribution of expression by two or

[70] As a result of the United States' accession to the Berne Convention effective March 1, 1989, certain formalities are optional but the incentives to follow the old formalities are great. See 17 U.S.C. §§ 408-412.

more people who intend to create a joint new work. Questions also arise when a work is created for hire, on who becomes the owner.

■ Nimmer

The suggestion by Reese Jones and Max Whitby that every copyrighted work contain a code with name of author, title of work, and copyright information is an outstanding idea. But even if it were to be implemented across-the-board today, it would not solve the copyright problem until the year 2065. Copyright lasts for 75 years in this country. A musical work fixed in 1977 is not going to have the code on it, nor is text from a 1930 novel, nor a photograph taken in 1987. All these materials will remain protected by copyright for 75 years after their publication. The *multimediator* (to quote George Coates) wanting to take advantage of these materials has no way of knowing at the outset the status of the copyright protection. Unless some service can go back and put a code on every antecedent work, and every copy of every such work, the code is not a practical solution.

Whitby

When a television program or film is put together, people spend a great deal of time and effort establishing very precisely what the copyright status is. All I am proposing is that this copyright information be encoded, perhaps with information on the protection of past works, and recorded digitally with the material.

Nimmer

It's an excellent proposal and I fully support it, but I must emphasize that the problem Reese Jones ran into, where he thought he had obtained copyright permission when he hadn't, will recur for the next 75 years unless we have absolute uniformity in codes. The best solution in an ideal world would be to have a computerized Library of Congress as a central repository of all information. Then I could dial up a Japanese translation of *Portnoy's*

(Nimmer)

Complaint on my computer and be charged by the minute. Part of the fee would go to Philip Roth and part would go to the Japanese translator. That would be ideal. But the technologists here say that the idea of going back and digitizing every library and archive will not be practical for decades.

The immediate problem is what to do with existing copyright laws. Robert Winter mentioned the political nature of multimedia, and Richard Lanham discussed the concepts of authority and author. Copyright presents the quintessential political problem. Congress has the authority to act. It has the power to redress the imbalances and terrible transaction costs that attend copyright. But it has abdicated this authority. Today, the author of copyright rules is essentially the courts, and courts move in incremental steps.

Our task is to find the building blocks from which we can construct, within the existing fabric of the law, an edifice that makes multimedia possible. I will focus on the compulsory license. I think it's a vehicle that offers hope for accommodating all interests.

In American law, copyright is a species of property, and property rights typically are untrammeled. As the owner of property, the copyright owner can decide to give his property to you, license it to you for a dollar (or a million dollars if he insists), or refuse to give it away at all and issue no license.

Starting in the early part of the century, Congress retreated from this notion of absolute property ownership by implementing, in a 1909 Act, a compulsory license for musical works.[71] This provides that once Bing Crosby records "White Christmas" for sale to the public, anyone has the right to record "White Christmas" — without permission of the copyright owner —

[71] 17 U.S.C. § 1(e) (1909 Act).

by paying a nickel per record sold or an adjusted amount stipulated by the copyright royalty tribunal. Instead of a consensual license, which copyright owners can give or withhold at their option, Congress imposed a compulsory license subject to certain exemptions. Jukeboxes, for example, even though they constitute public performance of music, started out as being exempt from paying copyright royalties under the 1909 Act, and progressed to being subject to a compulsory license under the later 1976 Act.[72]

This is the background for the compulsory licensing created early in the century. With amendment of the copyright law in 1976, Congress reenacted the first compulsory license and added three more. The most notable of these was for cable television.[73] Congress could have made cable television exempt, but did not. Or it could have made licensing consensual. The problem with doing so is that a viewer might be watching cable television for an hour, then the screen would go blank because the cable television operator was not able to purchase rights to the next program. Or the screen would stay on, but the sound track would stop because the owner of the music that was synchronized refused to grant a license for the music. What Congress chose was a middle ground — a compulsory license — a license granted by force of statute.

In 1988, a watershed year in the revision of copyright law, Congress imposed a fifth type of compulsory license, one intended to allow people in rural areas to receive retransmitted television signals on their satellite home dishes.[74] Responding to the necessity it saw for every household to have TV, but not wishing to compromise proprietary rights, Congress once again chose the middle ground of a compulsory license. But in a fascinating

[72] Compare 17 U.S.C. § 1 (e) (1909 Act) with 17 U.S.C. § 116 (1976 Act). See also 17 U.S.C. § 116A (1988 Amendment).

[73] See 17 U.S.C. § 111.

[74] See 17 U.S.C. § 119 (1988 Addition).

(Nimmer)

departure, it passed an interim compulsory license, one that would only last for so many years and then lapse. Granting an exemption from the antitrust laws, Congress instructed the various interest groups to get together to negotiate an agreement on how satellite retransmission would be handled once the compulsory license lapsed.[75] This approach might be the right paradigm for future solutions in multimedia.

The computer makes rapid diffusion of copyrighted materials incredibly easy and quick. For the copyright laws to be vindicated, there has to be a way of providing a return to the authors. The challenge is to find a way that facilitates the technology. Various attempts have been made to stifle the technology, such as the blocking chip designed for use here and in Europe to prevent DAT tape recorders from being used for copying purposes. Personally, I think the disabling chip would itself be disabled. The technological fix is not going to work.

The other way to address the problem, as was done in several European countries, is to impose a rough-and-ready tax on the means of copying. Every time a blank tape is sold in France, a percentage of the sale price goes to copyright owners of music. The problem is that people dictating tapes pay too much and people massively duplicating tapes pay too little.

The vehicle that may offer a possible solution is collective bargaining among user and owner groups. Continental scholar Adolf Dietz calls this the *syndicalistic* approach. It is a return to a kind of guild mentality from the Middle Ages, where the writers of textbooks in physics would band together to come up with a bargaining position on how much to charge for access to their works, and users of architectural drawings would band together to come up with the amount they were willing to pay for access to architectural drawings. Then the various user and owner groups would all negotiate.
If collective bargaining were strictly voluntary, Reese Jones would still have

[75] See 17 U.S.C. § 119 (c) (2) (B).

the same problem. Even if he has complied with the royalty obligations, he might unknowingly be dealing with an author who refused to join the syndicate. Or Congress could impose collective bargaining on a compulsory basis. If the courts are willing to be overreaching, they could themselves impose a compulsory license, as has been done in several court cases in the past.

This type of guild practice has gone on in this country for many years. ASCAP and BMI represent composers. If other author groups would band together as the composers have, and if user groups would band together, there could be collective bargaining. It would not be a panacea. It would not solve all problems. But it is the closest that existing law comes to posing at least a hope of a solution.

Firestone

Let me start off the questioning by asking what Disney can do to prevent Mickey Mouse from being used in a porno multimedia program.

Nimmer

That's not a fanciful question, as I'm sure you know. Disney sued the air pirate distributors of a pornographic cartoon and won.[76]

In Europe, copyright is viewed as a personal right. When an author creates a work, there is a *droit moral*, a moral right that prevents anyone from desecrating or violating the integrity of the work.[77] Although I'm sympathetic to that approach, I see it as inconsistent with our desired diffusion of media. Richard Lanham talks about someone reading a text, adding his own comments, making them available for other people, then having others store supra-comments on the comments. All of this material becomes available to the

[76] Walt Disney Productions v. The Air Pirates, 581 F.2d 751 (9th Cir. 1978).

[77] See generally Berne Convention (Paris text), Article 6 bis.

computer user who wants to take advantage of it. Given such diffusion, Disney's only option would be to say, "We disapprove; if you like Mickey, do not watch this." But Disney should not have the legal sanction of preventing people from watching Mickey Mouse in an unaccustomed form.

Glaser

I have a question about the state of the law. I can think of a few cases where I thought I saw limitations to compulsory license. One was Sid Vicious singing Frank Sinatra's *My Way*. It was actually blanked out. You could not hear any audio. I guess the copyright is owned by Paul Anka, who wrote the song. Another case was a rap band that recorded a somewhat obscene version of the Beatles' song *I'm Down*. Michael Jackson, who owns the copyright, refused to allow the record to be pressed.

Nimmer

You're exactly right. In this country, moral rights are not recognized, with the one major exception you hit upon. When Congress granted the compulsory license, it said anyone can use the musical work so long as the melody and character are not fundamentally altered. To refer back to my earlier example, there is a moral right in preserving *White Christmas*.

Glaser

But how does that apply to Sid Vicious? He may have been singing off key, but he was using the right words.

Firestone

We don't know who blanked him out.

Seybold

Is *sampling* or *scratching* the next step?[78] I've heard all the controversy. I'm curious about your view on this.

[78] Sampling has been discussed in detail in articles in *Rolling Stone* magazine.

Glaser
Also, what is the law on this? I find it confusing. I don't think any of the cases have gone to trial yet, have they?

Petrich
It's still unsettled, but I think sampling will ultimately lose. Remixing and altering the quality of the original sound recording certainly would be an infringement — at least of the sound recording right.[79]

Glaser
But is the use of one chord an infringement?

Jones
The preparatory work involves setting a time threshold. Should it be two bars, 500 milliseconds, 200 milliseconds, or something slightly less than what can be recognized as coming from the original work? They use SoundEdit in these legal cases.

Nimmer
The test is whether it is substantially similar.

Glaser
If you're a guitar aficionado, you know Eric Clapton by one chord.

Nimmer
Then that might be enough. The law does not state that two bars are okay, but three bars are over the line.

Glaser
It sounds like compulsory licensing is a nice start, but it would not help that much in multimedia. We are going to be splicing, sampling, and merging to

[79] 17 U.S.C. §§ 106 (1) (2) (3) (4), 114.

our heart's content. Compulsory licenses will only get us going. They do not solve the whole problem.

Firestone

In addition, if there are ten thousand items, the cost could be very substantial. Compulsory licenses could get you in over your head.

Glaser

Radio stations have a compulsory license. They make payments to BMI or ASCAP.

Firestone

That's not a compulsory license.

Glaser

It's negotiated, based on such things as the amount of a song's air-time and how frequently it's played.

Firestone

Payments are calculated as a percentage of the revenues.

Nimmer

It's a blanket license. A radio station will typically pay one or two percent of its gross revenue to ASCAP. ASCAP has its own formula for taxing the stations.

Glaser

Do these more generic compulsory licenses specify a revenue formula, or is it ambiguous?

Nimmer

For much of what I was suggesting, I was embroidering on the present to try to develop a possible framework for the future. You are welcome to define its parameters.

Stulberg

My background was in copyright law before I went straight and got into business. At AIM, we have worked with these issues a great deal. We have utilized three reference frameworks. First, we have adopted the compulsory license approach to the recording itself, without the theory that fixation of the music and images above it requires synchronization. For the time being, the SPA has gone along with the idea that a nickel a copy is sufficient. This assumes a multimedia approach that relies heavily on a piece of identifiable music. You buy the exigencies and economic burden of that decision.

If, instead, the music is used generically for the purpose of enhancing the multimedia, there are two other frameworks to consider. One is the *needle-drop library*. There are a number of them. You should deal with a responsible one to avoid the problem Reese Jones had. What you are buying, essentially, is a piece of music owned by a company. You can acquire it for whatever is the established rate.

The third approach is to make an original short composition of the work at nominal cost. Multimedia uses a lot of audio for narration. It's enormously effective to have a single or double instrument do what we call original music. But to stay in control of the music, make absolutely sure that the person who does the composition for you signs a contract as an employee for hire. I think most multimedia users will find, as we have, that this is a relatively quick and inexpensive way to develop multimedia programs.

Stein

I want to raise for discussion two major problems we face as a publisher with well over a hundred products. We come up against these questions all the time. First, what is the value of a piece of material in this new environment? Take a film, for example. I can go out and license a film to put on a videodisc in its entirety for a flat fee of $5,000 or $10,000. If I try to license a two-minute clip of that film, it may cost just as much. This is because clip rights have historically been sold either to television or motion pictures, where $5,000 or $10,000 for a few minutes is not unreasonable. But it's

completely unreasonable in an environment like mine, where the clip is a very small part of the program and the revenues are nothing like they are in television.

We have the same problem with photographs. It's not unreasonable to pay $50 or $100 for a photograph that is one of fifty in a book, but it's *completely* unreasonable if it's one of ten thousand on a videodisc. The absence of experience on the part of copyright holders on what their material is worth in this new multimedia environment can make negotiations with them extremely difficult. This problem is going to take a long time to settle.

The other problem is more complex and philosophical. Literature has had a concept of *fair use* for a long time. If I don't like something in a book, I can take a paragraph from the book, critique the hell out of it, and nobody's going to sue me. On the other hand, if ABC does a report on Vietnam, and I want to critique the way it is presented in the mass media, or if Proctor & Gamble does an advertisement that I want to critique, I don't have access. I cannot quote from the material. We would love to do a critical videodisc that educates people about how advertising works. We can't do it because we can't buy the rights to the advertisements. Our lawyers don't think we should just go ahead and use the advertisements without the rights.

So much of our culture in the last 30 years is represented in motion picture material. Yet serious authors cannot quote from the material to critique it. This stands in the way of our ability to discuss and understand our culture. It's a very serious problem.

Nimmer

Are you contemplating putting a whole television commercial on as one segment, or just a few seconds' worth?

Stein
A whole commercial.

Nimmer
A whole commercial, with annotation? That's a tough issue.

Stein
My lawyers tell me that it does not make much difference whether it's ten seconds or the whole thing.

Firestone
Well, I don't know. But with multimedia, you miss the advantage of the medium when you don't give viewers the ability to see for themselves the whole commercial — the full subject of your criticism. Just settling for a few extracts loses the essence of the medium. But you said you can take a paragraph from a book. If you took the whole book, it would be the same thing as taking the whole commercial. If you take a piece of either, and comment on it, then it should be *fair use*.

Whitby
Earlier, we proposed encouraging consumers of multimedia to become authors by providing tools for adapting the published content. What then happens if I publish a CD or videodisc containing someone else's material that I've licensed, and give it to a school, encouraging the children to make their own versions of the material? Will I need heavy-duty, cast-iron rights to do this, or will the law be more reasonable and flexible in this case?

Petrich
If you do not watch out, you may be a contributory infringer, which makes you liable for whatever the children do. But there are precautions you might take. You probably should have a license arrangement with the school that limits the uses students can make.

Jones
If the objective was to make flawless copies or reuse the material for other purposes, the use would by definition be a violation of the copyright law.

Petrich
Still, I can imagine many lawful uses within the classroom. So long as the children do not make new works to sell or publicly perform, or do any of the five things I mentioned earlier, there should be no problem.[80]

Whitby
Does showing it to other members of the class constitute public performance?

Petrich
Probably not, unless they charge for it.

Brannon
Are you permitted to use such a multimedia work for research, to see if it is marketable, without marketing it?

Abel
He means a prototype product from which no financial gain is realized.

Petrich
I think it's probably a *fair use* up to that point, but I tend to be user-oriented. A proprietary-oriented lawyer might have a different opinion.

Brannon
The reason for my question is that many of us are doing demonstrations that are on the edge of abusing the copyright law, where we say the demonstration is for research and survey only, not financial benefit.

[80] See 17 U.S.C. § 110 (face-to-face teaching activities in a classroom).

Petrich
It would have some financial benefit if it's promoting your product.

Brannon
Yes. Well, we're researching.

Glaser
There's no problem of commercial gain for the DVI operation in the short run.

Abel
I can give a practical explanation of what prompted Bob Brannon's question. Our multimedia work, *Guernica*, was mainly a demonstration piece. Some things in it belonged to us, some did not. It was a demo which we did for ourselves (three of us), and no one sued. We realized there would be no financial gain from it and we would never really get it published. It was too complicated. Yet *Guernica* has been on the front page of the *New York Times*. Max Whitby has included it in his documentary.

The next piece that we did, *Ulysses*, was done for IBM to be shown in public. Now there was potential risk. Even as a demo piece, there was obviously potential financial gain. So we had to clear rights for it. I come from a background where clearing rights is a standard everyday thing, like brushing your teeth. There is a very practical set of systems for clearing rights on film, tape, music, etc. In the case of *Ulysses*, we simply wrote a letter, showed the script, and explained basically how long the work would be displayed and what the purposes were for displaying it. It took 27 days to get the releases signed — for under $5,000 — from the time of starting the job and pasting down our first image to completion, including clearance of all rights.

The reason I bring this up is to give a practical demonstration of procedures used by many before us, like David Wolper and those making documentaries. People are interested in granting rights. Many of them, in fact, much to

our chagrin, surprise, and delight, offered the rights for free, saying, "Look, as long as you're only going to use it for this!" That included Peter Gabriel, Graham Nash, and the executor or trustee of the Joseph Campbell Estate whose footage we used. We found many people to be very helpful. We just had to be straight with them — and specific.

Eventually, when this becomes a money-making business, we will have to negotiate percentages and make deals like favored nation clauses in music. These can get very expensive.

Firestone

Ching-chih Chen said that she had trouble getting full copyright for her program.

Chen

I think the kind of licensing agreement Robert Abel was obtaining was mostly for audio-visual material. That may be easier because the owners of this material understand better what multimedia is. I own copyrights for most of the visual images on our two discs related to the first Emperor of China, but need text information to support these images. The text information comes from printed sources, which gave us a lot of trouble. To start with, our project is in the subject areas of art history and archaeology. Print publishers in these areas generally do not understand multimedia applications very well. Their first question was, "Why do you want to put our text on a computer anyway?" The more we went back to them, the greater the trouble. I finally decided, for all the time it took, to adopt the following approach. For small text material with a couple of paragraphs, we would insert a note saying, "Due to copyright law, full text cannot be provided here." This is not the ideal solution, but it's just very tough to obtain permission for everything.

Abel
Were those print sources fairly contemporary — within the last 75 years?

Chen
Absolutely.

Seybold
In printing promotional materials at my company, we bring in photographs by computer and do things with them. So, first, we have to license the photographs. Then we have to get a special license to crop, since that is different from what the photographer originally intended. It gets worse. When we go back and say we want to change the color of a photograph, and combine it with another photograph, they become totally unglued! To them, this is destroying the original artistic premise. They have no way of coping with it. And that's just for a simple photograph!

Firestone
Unfortunately, we have to bring the session to a close. Let me end by posing some central questions. Robert Winter talked earlier about the importance of good content in the final product. Is it possible that not having something necessary for lack of copyright availability could alter an entire work? If so, we might consider David Nimmer's proposal for a compulsory license. Or, is there a need to change the law? Is the law the problem? That's the most central question of all.

Roundtable Wrap Up

Nicholas Negroponte, Moderator
Nick Arnett
Jonathan Seybold

By the time of this concluding session, it was clear that the first objective for holding the Roundtable had been served. Participants from different backgrounds who might not otherwise have met were sharing experiences, insights, and perspectives. Discussions begun in the meeting were continued on walks across campus, at mealtimes, and back at the Guest House. What was not as clear was whether progress was being made in forming a basis for taking constructive steps — the second objective of the Roundtable. Nicholas Negroponte approached his responsibilities as anchor moderator warily. We had asked him to elicit ideas for cooperative action — the third and final objective of the Roundtable. Believing the group had been missing some key issues, he opened the session by pointing out what he saw as important omissions. Jonathan Seybold and Nick Arnett followed with masterful attempts at summarizing and characterizing the discussion. The ensuing exchange evoked many good points and an unexpected number of action items. For any closure or consensus, we will have to look to the longer term, a subject of "In Retrospect," the final chapter of the book. The final chapter also includes a summary of the action programs proposed during the Roundtable.

■ Negroponte

I can't resist starting with a joke, which is not my custom, but it characterizes the state we are in right now. A German and Italian general are fighting a battle together. As things worsen for their side, the German general turns to his ADC and says, "Get me my red jacket." The Italian general looks at him in surprise and asks, "Why are you ordering your red jacket?" to which the German general replies, "When I go to war and feel I'm going to get bloodied, I like the color of my jacket to blend in with the blood, so it doesn't look badly." Whereupon the Italian general turns nervously to his ADC and says, "Please get me my brown pants."

Today, in 1990, the networks are in some sense wearing brown pants. Multimedia is a serious problem for them. The consumer electronics companies are wearing red jackets. They are the ones who may get bloodied.

My job is to moderate this final discussion. As moderator, I would like to point out five things that were either not talked about or were subsumed in the discussion.

First, I cannot think of a simpler two-word definition for multimedia than *sensory concurrency*. Such concurrency can consist either of related or unrelated activities. For an opera, which is certainly multimedia, the concurrent activities are clearly related, as they are in *Guernica* and in computer applications that synchronize the media components. Yet the future is with concurrency where media activities are unrelated, where you look at a picture and simultaneously talk about something which may have nothing at all to do with the picture. There has been no mention in the discussion of this aspect of multimedia.

The second topic omitted has to do with face-to-face communication. Two people in a heated face-to-face exchange are the closest human analogy we have to multimedia. But, interestingly enough, when we refer to multimedia in computers, or in the context of consumer products, it's *mostly* (not en-

tirely) in the output domain (although Nintendo games do provide symmetry, and the *Power Glove* is a wonderful multimedia device). We have not talked or thought much about this.

The third topic omitted I'll call *transcoding*. The general view of multimedia is that certain streams of different media meet at the screen, with information intrinsically stored in each medium. Looking into the future, this idea of intrinsic storage may be a grotesque oversight. The true future of multimedia is likely to be in transcoding information.

Let me give you a simple and then a more complicated example. In the simple example, I'm reading a book on my handy, dandy *Dynabook*. I'm getting tired and it's late. Finally, I put the *Dynabook* on the night table and say, "Okay, just read me the rest of the chapter." The *Dynabook* reads out loud, *transcoding*, if you will, the text to speech.

In the complicated example, someone sitting at a computer 30 to 40 years from now says, "I didn't really understand that. Make a movie of it for me." And crunch, in a few milliseconds, the computer generates a movie.

No one has raised the transcoding issue here to my knowledge. It seems important to me.

Fourth on my list is an idea that has been mentioned, but only in nibbles. It has to do with the degree to which the user of multimedia will, in fact, be making the material. The nicest nibble was in Max Whitby's observation that you learn a lot when you do the cutting for a documentary film.

Marvin Minsky at the MIT Media Laboratory has a great example with frogs. Most of us are old enough to have been subjected to dissecting frogs at school. The notion that we would learn about a frog by taking it apart seems a little grotesque. A multimedia disc might conceivably allow us to dissect a

(Negroponte)
virtual frog with the right output and input apparatus, so we could spare these poor animals. But this is probably not the way to learn about frogs. The right way is to build a frog. We've never before had the technology to build frogs. We've only had the technology to take them apart. A nice way to think about the future of multimedia is that we're going to give people the technology to build frogs and, as a consequence, learn about them.

The last of the omissions was in not calling attention to the fact that whatever we produce over the next two or three decades — however it's produced — is going to be read by machines, not people. The notion that people will be looking at all this stuff is a myth. In fact, television will be looked at by computers. I will come home at night and my set will say, "Nicholas, I saw 32,000 hours of TV today, and the following 15 minutes are really interesting. I've recorded them for you." That's probably the way it will go. This prospect has not been touched on at all in the discussions.

Having focused on what I feel were significant omissions, let me now point out one omission that I think was absolutely wonderful. It made my day.

There are two groups of engineers in this business (some companies, like Sony and Philips, have both kinds). There are engineers putting an increasing amount of computing into TV sets, and other engineers putting an increasing amount of video into computers. Now, this is curious, and I don't mean to insult anyone, but in most companies the two groups are not talking to each other.

Some people think the next evolutionary step in television will be high definition, which is mind boggling. They really believe that doubling the number of scan lines will do it. We know the real evolutionary step will come instead with what we've been discussing around this table, even if we don't agree on all the details. We are not talking about going from 525 to 1125 or 1250 lines. It's a major evolutionary step we're debating — and that's good.

■ Seybold

I will pick up from where you left off. There is a subtext that has wended its way through the whole discussion — the collision between the personal computer and consumer electronics industries. It takes on overtones, because the computer industry is basically American — the United States sets standards for the world — whereas consumer electronics is basically Japanese. The collision is therefore in some ways a face-off between the United States and Japan. It will be interesting to see how it plays itself out.

Now for some random notes from the discussions. One thing I detected was a dichotomy between the do-it-right visionaries on the one side (I would put Nicholas Negroponte and Alan Kay in that camp) and on the other side, those (including myself) who put higher priority on the need to get products into the field. We need real experience from real people using real products doing real things. We are far from knowing how to use the technology effectively. We need much more experience and a lot more feedback. That means making do with the technology we have, developing a market for it, and assuming risk. The risk is that we find ourselves stuck with premature standards later on because we put preliminary products into the marketplace that, lo and behold, got accepted. Then we have the problem of dealing with an unsolid base.

I'll give an example of why I worry about this. Take the CD form. We are stuck with a 4.7-inch compact disc because the president of Sony decided he wanted a disc that would hold *Beethoven's Ninth Symphony* as performed by Von Karajan. That is how big the disc had to be. Now we are going through machinations trying to fit two hours of motion video onto that same disc. I don't know any way out of the dilemma, except to identify and be very aware of the problem as we go forward. We must think about balancing the need for getting things into the field *now* with not locking ourselves into *de facto* standards we will later regret.

One thing that intrigues me about this field is the way it can enable creative people like Robert Winter and Bob Abel to build worlds for others to explore.

(Seybold)
That kind of control is very rare. Doing a film is a much more collaborative process. The greatest hope in successfully exploiting the technology lies with the authors, and with empowering people to do really interesting and creative things. This involves learning how to work with a medium that is getting more and more interactive and non-linear. We have a lot of adapting to do, because we've spent so much of our cultural history working with linear forms. We must also find out how to do what Max Whitby and Nicholas Negroponte are talking about, where we are not just presenting material to people, but giving them the ability to learn by experiencing and by doing. We all know that's the best way to learn.

What it's really all about in the end is developing tools that empower people. I'm convinced that photographic hobbyists — the same people who now play with an image on an enlarger — will move out of the darkroom onto the computer screen. They will grab these tools in much the same way that people in music grabbed the MIDI tools. There is so much potential to take information, recombine it, rework it, change it, and learn in the process.

This leads to the discussion about property rights, for which there are no ready solutions at this point, and also to the troubling observation that much of what we are trying to achieve is in direct conflict with the existing organization and practices of educational institutions. It is at odds with everything about the current educational structure. The suggestion that we try to adapt the technology to fit the way schools work may be reasonable, but I'd like to suggest a more radical, longer-term approach. I think we should rethink our educational institutions to take better advantage of the technology.

■ Arnett

At our firm, Tim Bajarin and I have reached some strong conclusions on how multimedia is likely to develop. The pattern we see is top-down. We believe business will be the first to adopt and pay for development of the technology — professional communicators doing training, merchandising, and point-of-

sale applications. There will also be some development from the consumer market upward, but because of the high price of systems, not nearly as much as from the business market downward.

Many of the key players in multimedia have not revealed their strategies. It's very difficult for other people in the industry to know where to go, when to develop, and what will be possible until they hear where the large companies are headed. IBM and Apple need to declare. They do not have to preannounce products, but they should make their intended directions clear. It will take big companies to get things going.

We did not talk much about channels in the sessions, but in private conversation the point was made that multimedia has hardly any Value-Added Resellers (VARs), the people who sell the integrated hardware and software. This marketing channel just doesn't exist. If you want to be a Bob Abel, where do you go to buy the parts?

There were two levels of treatment apparent in the discussions: one evolutionary, the other revolutionary. On the one hand was the progression of the computer interface, going all the way from plugging in wires or turning rheostats, way back when, to what is now called the *graphical user interface* and will soon be the audiovisual interface. Like every interface improvement before it, this will evolve into new applications and broaden the number of people who can use the computer.

On the other hand, there was also revolutionary language in evidence. Several participants spoke of multimedia changing the way we work, think, learn — everything. I think this is the reason for some of the argument and disorder. The revolutionary attitude is not geared to the mass audience and accords only limited relevance to prior art. Those of us wedded to a long tradition of research in human interface design are not ready to put that tradition aside.

(Arnett)

An observation made at many sessions is that everyone who sits down to create multimedia discovers it's much harder than they expected. I never heard anyone say it was easier than expected. We can count on that continuing. On the other hand, there is the interesting new criticism, expressed best by Alan Kay, to the effect that much of multimedia is too easy to use. I think that's right. It's a strange situation. Multimedia is too hard to make and too easy to use.

Jack Sculley made a good point about what's really important in multimedia. The first step is nifty hardware, after which everybody says, okay, now we need content. Jack pointed out that it's not just the nifty hardware and the content, it's what you do with it, the *experience* you create.

Last summer I came up with a three-layered reference model for considering the benefits of multimedia. Multimedia is good for motivating, orienting, and introducing new topics. Once interested, you need a navigation system to get you somewhere. You have to be able to imagine someplace you haven't been. The computer can take you there. Once you get there, you want to acquire information. The audiovisual element is then of more limited application. It's very good for showing things with motion, such as ballet, and for taking you places you physically cannot go (which has always been a feature of television), but it's not as good for retrieving information.

Those were my three layers until I realized that there's a very important fourth layer — the one Jack meant. After going back and forth through the first three layers, learning things and navigating places, you want to be able to create something new. You want to be able to synthesize what you've learned. That's the fourth layer — the kind of building tool that's in the ABC News videodiscs for creating your own documentary. It's vitally important and often overlooked. Teachers tend to like it.

Speaking of teachers, I come from a family of teachers. My parents were both teachers and my sister teaches at an extremely poor public school where she has had to buy textbooks for her students. That tells you how far her school is from having computers. Computing presents too much change for many teachers and is too expensive for many schools. Those are serious obstacles to overcome. Somebody will have to figure out how to get computers into the schools and reach the reluctant teachers. Luckily, there are many very good teachers who don't regard computing as a threat.

Maybe it's a twisted view based on the people I see here, but it seems to me that some of the best and brightest in this country are being attracted to multimedia. That's good news. It makes me feel we can make it. At the same time, we have identified a nest of political, legal, and economic obstacles. I think the answer is Robert Abel's quote from the Nike ad: *"Just do it."*

As television was evolving in the 1950s, a big sponsor of television content was General Electric, with programs like the General Electric Theatre.[81] What was General Electric doing? Selling television sets. Where is Apple Theatre and IBM Theatre today? True, IBM paid for *Ulysses*, and Philips is putting tremendous money into producing content for CD-I, but we need to see more. At some point, advertising budgets should start to provide the financing required.

Let me skip now to a few ideas for the action items Martin Greenberger requested. In the legal area we could mount an effort to look at compulsory licensing. We could also promulgate the idea of attaching copyright and perhaps indexing information to data files. We could work on the problem of defining terms, so there's some standardization in their usage. I feel strongly that HDTV is a technology crying out to be ignored. ISDN and

[81] From research at Stanford University on the evolution of new media.

(Arnett)
broadband ISDN, on the other hand, are technologies warranting joint industry effort and political lobbying to remove the obstacles. We need to have fibers installed as quickly as possible.

There is a White House task force on technology transfer trying to find ways to transfer educational technology into the public schools. It's a very worthy task, but as Richard Lanham pointed out, there's also opportunity for the opposite kind of transfer: knowledge from the arts and humanities into our business. We need to transfer over, in particular, some of the audiovisual production skill of people like Bob Abel, who come out of Hollywood. We could look at both sides: technology transfer into the arts and humanities, and the transfer of arts and humanities into technology.

Negroponte
Since our instructions are to come up with action items, we will now open the floor to whomever has one to suggest.

Bajarin
On the education front, as Robert Winter mentioned, we need to go out and deliver the message, showing the technology to schools and educators. Philips may do this as well. An action item I know is important to those of us communicating is to become evangelical in demonstrating what the technology is about. For the academic community, we might do this in an organized fashion at educational conferences.

Stulberg
That is exactly what we've been doing in drawing attention to CD-I. At the request of a number of academic units, such as the UCLA department of education recently, we have been explaining interactivity and its potential applications to visitors. We are keynoting the American Association of

Community and Junior Colleges national convention next month, and the SPA convention in the fall. You are absolutely right. Multimedia and interactivity seem to be a big dark secret right now in terms of general awareness, particularly in the educational system. There should be a concerted effort to broaden the knowledge and understanding of what's happening.

Luskin

My action item is directed at Martin Greenberger, Richard Lanham, Robert Winter, and the other people at UCLA who have a sense of this area. Unless we get some professional school programs started in interactive product design, it will never become a professional field. Whatever the format turns out to be, companies are going to be spending hundreds of millions of dollars in the development of interactive media-related material. We've broken the back of the hardware problem; we know how to make authoring systems; and we understand software engineering. We are already hiring many of the software people coming out of computer science programs. As small as we are at AIM, we probably now have about forty of them.

Finding people with the ability to construct sensitive interactive material is like finding a needle in a haystack. I can count the people I know who are able to do it well on the fingers of my two hands. There is a program blossoming at George Washington University, and some frail movement at USC. But there is no conscious effort to develop a coherent discipline so that people struggling with this technology today can use their newly honed skills to bring forth a new generation with the ability to take the next step. I know how long it requires to develop such a program, and how much effort it takes to think it out. UCLA, among whatever other universities would be interested, certainly is the right kind of place. And we've identified at least a few of the people here who could give leadership to this effort.

Arnett

I'd like to point out, before anybody is offended, that the MIT Media Lab is set up to do what you want, as is Brown University's intermedia project. I think it would be a mistake to leave out Nicholas Negroponte's work in this regard.

Negroponte

Nicholas Negroponte is on AIM's brown-pants list, so it's okay. We have 90 people working towards Ph.D.s and M.S.s at the Media Lab who come from precisely the relevant backgrounds. I think AIM has hired quite a few of them. But I'm not saying Bernard Luskin's point is a non-issue.

Bajarin

The question is, are any of the people at the Media Lab engaging in a concentrated effort to communicate? I've talked to some college professors who have looked at what you're doing with great interest. But it has not translated beyond "This is really of great interest."

Negroponte

One of the well-kept secrets of why the Media Lab exists is that MIT had no art department, no education department, and no film department. We were able to build a laboratory that did not tread on anybody's intellectual turf. It was able to gather the filmmakers, the photographers, the musicians, and the computer people in one place. At UCLA, you'd probably be shot for doing that. The art department would say, "Hey, that's our turf," and the music department would say the same thing. We lucked out. In most university settings, it would be very hard to do.

Luskin

I understand how hard it is to do. Nick Arnett said to me, "Bernie, don't worry about it; they're doing it at MIT." Well, they're not doing everything at MIT. I respect what they're doing, but if this is going to be a billion dollar industry, it will take a conscious and deliberate effort to develop the profes-

sional skills of people to do the work and spend the hundreds of millions of dollars it will take to develop products. It has to be consciously thought out. You are not on my brown-pants list, Nicholas. It was a pleasant discussion, and we are going to have to work it all the way through to resolution. But education in this field is going to take more than one place. It's going to take the disciples of one place to go to another place to start a program there. It has to be a worldwide effort.

Jack Sculley

While we are still discussing education, let me say that I do not see the problem as a need for evangelism, since people like Robert Winter, Bob Abel, Ching-chih Chen, and Max Whitby are already talking to educational institutions and to others not previously exposed to the technology. The need is rather to make creation possible. IBM deserves credit for making *Ulysses* possible. That kind of partnership is what's required. There certainly is a role for development within organizations, like at the Media Lab and Philips, but there also must be inter-institutional cooperation. We need to develop a climate for mutual trust. The computing powers that be have a morbid suspicion of small bands of artists. We need to turn this around in some way. No one person has the answer. We should revel in our dissonance. To avoid a straight-jacketed technology, we must open up the artistic space and take some positive steps. We should begin a dialogue among everyone here to see what these steps might be.

Jones

My humble proposal for serving the educational community is to integrate the telephones, computers and video equipment that schools have today with inexpensive serviceable products that allow the faculty and students to create the content they know best. The alternative of requiring a $20,000 or $50,000 multimedia authoring system to produce millions of units does not fit in with either a university or grade school. Grade schools have PCs, Apple IIs, Macintoshes, VCRs, TVs, and telephones. Such equipment is

easily integrated without major expense or new standards. Serve the educational community with products that solve its problems today.

Stein

Going back to what Bernard Luskin was suggesting, we have found without exception over the last six years that the people who have come to us from interactive design programs have been the least interesting, because they come with concepts of instructional design, not a passion for communication. We have generally found that the odd English, art, music, or history student ends up having greater talent on average. So I'm not sure I would encourage more programs in instructional design. What I would encourage is some way to jump start the creation of more Robert Winters. This must be done consciously and with much thought.

Robert is a tremendously creative person who has much to communicate. He also had the benefit of working for six months with six computer-trained people on a daily basis. This is an important part of the process. You cannot turn somebody who knows a lot about a subject area into an interactive multimedia author just by giving him a Macintosh. There needs to be time spent getting used to an entirely new way of communicating.

I would love to see summer institutes for professors and other people who have something to say, and who are passionate and excited about saying it in CD-I, HyperCard, or the multimedia systems coming out for IBM computers. Although this will take concentrated effort, it should not be too expensive. A coalition of IBM, Apple, and other companies with a few foundations could do something very interesting at one or two universities around the country.

Luskin

We have actually had good luck working with junior colleges. Many students coming through these schools in the evening already are content

providers. They have skills and are looking for targeted courses. The junior colleges complement the universities. The number of people we can reach through them is incredible. It's very cost-effective.

Brannon

I think Nick Arnett is going to publish a directory on who's doing what in multimedia, but I don't know if there's a directory on who's doing what in multimedia in education and the universities. It would make a good project for the vendors to sponsor, to have access to, and to promote.

Abel

As this conference is drawing to a close, with all the powerful and wonderful people here whom I respect tremendously, we still haven't decided on an action agenda. Let me see if I can propose a plan, and then volunteer to help make it work.

We were fortunate after having done *Guernica* to get IBM's interest in sponsoring *Ulysses*. Before we began the project, I visited with Max Whitby while he was working at home in England. He has done some very impressive tool building. There are many potential Max Whitbys.

My old company is about to have a reunion. We have located 1,243 people who passed through the company at one time or another. Among them, they won 11 Oscars. They understand communication. They had to in order to sell Coca Cola, Levi's, Seven Up, and other things that may not be that good for society. In answer to a question, 120 of these people indicated they would like to work in interactive multimedia, either as programmers or artists. I could hire many of these talented people tomorrow if I had the money. I could make a lot of titles. But where would I sell them?

We need the IBMs, Apples, Philips, and Sonys of the world — and other companies represented in this room — to step forward and say, "We want to

support the work of the top talents of our time." Robert Winter is probably one of the best presenters of music who ever lived. Frank Baxter was the greatest Shakespearean authority I knew. Raymond Redhaffer was the best math expert I ever met. (We did mathematics together at the office of Charles Eames.) With multimedia, we have the ability to immortalize the talents of these exceptional people and make their works widely available.

Someone must write letters to the companies. Since it's my idea, I'll do it. (I'm doing something with Jonathan Seybold right now.) There's an old Hollywood saying that goes, "If you don't pitch the script, nothing happens." All they can say is no. They might say yes. I'll go out and write the letters. Just give me the list.

The universities must do something too.[82] Jonathan Seybold put his finger on it. Don't wait to try and fight the curricula. Let the technology determine what the curricula should be.

I propose we take action now. Give me the names; I'll write the letters. But I've got to know that others will support me. We can do it. I would not have done the *Ulysses* project, except for going to England, meeting Max Whitby, and seeing some kids in Tienanmen Square who started to change history. So many things have happened because some people decided to take action.

The time to do it is now. I'm volunteering. I hope others will join with me.

Seybold

I'd like to take a slightly different approach. We have technologies from a variety of vendors, and we have designers who are experienced. What we don't have is a commercial process. Insurance firms, automotive companies, and the U.S. military create materials for use inside the organization, but

[82] Abel confided: "I received an inquiry from USC recently. It's heavily funded to set up a multimedia department. I probably won't accept the offer. I could never live with myself. I couldn't wear my old UCLA letterman's sweater, and my kids wouldn't talk to me."

outside, all that exists is the procedure of asking for grants from IBM or money from Philips. There is no commercial process by which a product can be created and sold.

The problem may be that we are drawing our models from software, books, and films — which are pay-to-own or pay-to-use media — instead of from newspapers, television, and radio, where vendors pay to get information to consumers. We should take note of the distribution channels and advertising revenues of the commercially subsidized media. That may seem vulgar in the context of something as wonderful as interactivity, but it's worth considering.

No advertiser is going to pay for a market that doesn't exist. The Anderson Graduate School of Management might help us break out of this chicken-and-egg dilemma. Until there is a real commercial process, multimedia developers may get their grants, but they are not going to have a business. Until there are people who want their products, want them to create these products, and are going to buy them, they will have to continue to go hat-in-hand demonstrating the concept.

Dillon

With all the great marketing and other expertise that exists at the Anderson School, we ought to be able to find a way to solve the chicken-and-egg problem.

Bushnell

If we really have such a powerful communication medium, we should use it to build a disc, tape, or other unit that communicates the wish and promise of multimedia. It should be a group effort — with each of us putting in a certain part of our vision — for use at trade shows in presenting an overview. If we believe in what we're doing, we should use the medium to communicate our dream to the rest of the world.

Arnett

Would it run on IBM, Macintosh, CD-I, or Amiga?

Bushnell

We should try to make it ecumenical in software, so that it can be run on any of these systems. Let the user choose the hardware.

Firestone

As an outsider looking in, here are a few of the items discussed that seem to me to lend themselves to an action agenda. First, on the financing question, I'll take a cue from Nicholas Negroponte by pointing out that we've talked about television, we've talked about telephone, but no one in the entire meeting has mentioned cable — a broadband link into 55 percent of U.S. homes that for twenty years has promised interactivity. Some cable companies now in trouble might be interested in financing multimedia. But beware! They are not very farsighted in their outlook.[83]

Second, we've said we need a common language. We cannot even define what multimedia is. We also need a common architecture. We need to be able to distribute over multiple platforms — create something one place and then distribute it more broadly. Third, if access to content is a problem, I thought David Nimmer's suggestion on the use of the compulsory license was the right approach. The last item is the most important one: developing people with imagination. It's also obviously the hardest.

Bajarin

I would like to ask Robert Lucky what is happening in multimedia in the communications industry.

[83] Nicholas Negroponte endorsed Firestone's idea about cable being a potential funding source. He mentioned a group called Cable Labs in Denver, Colorado that was put together about two years ago and receives so many cents per viewer per month for its operations.

Lucky

I'm ashamed to say that the communications industry is not where it's happening. The industry is looking to the computer people to bring it about. Multimedia could open up new markets for communications. Its markets are now relatively flat, growing by only 4 to 6 percent a year. We need to expand our bandwidth to save our business. Yet, at communications conferences, multimedia is not being discussed.

Brannon

I was intrigued by Mark Dillon's suggestion that the Anderson Graduate School of Management might do something to define, push, or structure the commercial process for multimedia. Were you suggesting that?

Dillon

Yes. I think there is a lack of understanding of the market forces that could come into play to cause people to take money out of their pockets and buy a multimedia product. I used to make films for *Sunset Magazine*. One thing I learned there was that the advertisements in the magazine were as valued by subscribers as the editorials. The magazine is clearly a medium for narrowcasting. There may be similar information niches for interactive media, where editorial content (as it were) and advertiser support can be commingled without getting users upset. To me, information is what I want to know, a commercial something a *vendor* wants me to know. The interactive environment is perfect for finding objective information as well as buyer-related information. Because of our tradition of advertiser support in this country, most information is provided to us free by magazines, newspapers, broadcast television, and radio. Why not by multimedia? I have not seen anything in the literature about how to break out of the chicken-and-egg situation and cause a commercial market to develop. Advertisers measure by cost per thousand. How about cost per one? The Anderson Graduate School of Management put on this conference. It's not a technology institute or software developer. Its comparative advantage may rather be in helping

us understand the marketing subtleties of multimedia. That's something this school might do that MIT or another university does not or cannot do.

Firestone

If advertising does creep into multimedia, which may be inevitable in certain areas, let us agree from the very beginning that it be clearly labeled as advertisement. In some areas of multimedia, however, I think advertising would be inappropriate because of its effect on how people would trust the system and regard the content.

Anonymous

Advertising is already here. Most CD-I content and much of what is promoted at trade shows on IBM and Macintosh computers, including the *Ulysses* project, are essentially paid advertisements for Philips, IBM, or Apple.

Negroponte

Prodigy is a better example of the mixture of objective information and advertising.

Abel

I wonder if this much thought and these many people came together when MTV was born. There were no standards for MTV, and there was no one ready to make it, yet it came about in less than four weeks. I know the history. MTV *happened*. It evolved. Kids came out of nowhere. Multimedia will admittedly have a very different form of distribution. Why are we having so much of a struggle with it?

Nolan, what was it like with *Pong*? What happened? How did you break through?

Bushnell

The hardest part was getting the game through a distribution channel. We couldn't get it through the toy channel. We couldn't get it through the TV channel. We were saved by the interest of one buyer in one store, namely Sears Roebuck. People ask us why we gave an exclusive to Sears in our first year. It was because of that fellow. He was the only one who wanted to buy the game!

I have a feeling that we may be in sort of the same situation now with multimedia. If you went down to the store and said, "I want to buy some of this here multimedia," you would get a very strange look from the salesman. There is nowhere you can buy multimedia at the present time.

Negroponte

It's time to close the meeting. We will let Martin reflect on the action items afterwards.

Greenberger

We obviously do need time to reflect, but we very much appreciate your good suggestions. There is one action response I can promise right now. It was requested by Bob Stein. We shortly will be sending the addresses and phone numbers of all Roundtable participants to each of you to help us stay in touch. We hope to reconvene at the same time next year. Until then, Jack Sculley and I thank you all and, for now, the meeting is adjourned.

The chemistry set in motion at the Roundtable continued to have an effect in the weeks and months following. In this final chapter, we take a retrospective look at what went on at the meeting, examine how well the objectives were served, and check on what individuals in the group have been thinking and doing in the months since.

The gathering at UCLA contained a rich mixture of people crossing boundaries in every direction. Among those profiled in the biographical sketches at the back of the book are:

- A creative showman whose prototype works are opening eyes on the broad potential of multimedia in business, education, and entertainment. (Robert Abel)

- An entrepreneur-cum-innovator who sparked the beginnings of the computer game industry. (Nolan Bushnell)

- An artistic director whose performances at festivals around the world mix opera, dance, music, and theater to create new sensory experiences. (George Coates)

- A maverick from Iowa who brought satellites to the newspaper industry and pioneered in developing on-line systems for financial news and information. (William Dunn)

- A woman with a social conscience who grew up on a ranch in the West and now oversees multimedia and education for the largest computer company in the world. (Lucie Fjeldstad)

- A guiding spirit of the personal computer world, whose broadly eclectic interests come together in a quest to understand how children learn. (Alan Kay)

- A classical rhetorician and expert witness in copyright, now writing on electronic text and its social implications. (Richard Lanham)

- A lead scientist at Bell Laboratories whose adaptive equalizer corrects distortion in telephone signals for all high-speed data transmission today. (Robert Lucky)

- An inventor of the first microprocessor-driven video and pinball games, honored recently by the entertainment industry for his innovations in editing technology. (Steven Mayer)

- The director and co-founder of a world-renowned university laboratory that pioneers in interactive media, perceptive technologies, and *Inventing the Future.* (Nicholas Negroponte)

- A lawyer and treatise writer responsible for the standard reference on copyright law, considered a bible in the field. (David Nimmer)

- An articulate and thoughtful spokesman for interactive media, who heads a top computer firm that has made a significant difference. (John Sculley)

- A British producer and science documentarian, considered one of the most creative and sensible practitioners in the field today. (Max Whitby)

- A piano-playing professor and commentator of music, who has received wide praise for the excellence of his carefully crafted interactive discs. (Robert Winter)

To cover the discussions of a group as varied as this requires a glossary of uncommon heterogeneity. The one compiled follows this chapter. The terms and concepts come from many fields. For example:

- *De minimus* and *fair use* from the law
- *Broadband, ISDN,* and *T1* from communications engineering
- *Aspect ratio, Interlace,* and *RGB* from television technology
- *ASCII* and *Object-oriented* from the computer field
- *MIDI* and *Sampling* from music
- *CD-DA* and *DAT* from consumer electronics
- *High-Stakes Testing* and *LOGO* from education
- *CAV* and *CLV* from videodisc technology
- *Shipping* and *VAR* from marketing
- *Minitel, Prodigy,* and *QUBE* from the field of videotex
- *CCITT, JPEG,* and *MPEG* from the standards community
- *CD-I* and *DVI* from interactive video
- *Broadcatch, Interface,* and *Narrowcasting* from the growing literature on *multimedia* and *interactivity.*

The discussions using these terms spanned all of the areas mentioned.

In Retrospect

Our aim at the Roundtable was to convene leaders from the many diverse fields feeding into multimedia and give them a chance to meet and talk. That objective was served. Participants repeatedly spoke of the value that came from discussions in the sessions, mealtime conversations, encounters in the corridors, and walks across campus. Many of the participants who did not know each other before the meeting indicate they are now staying in touch and continuing the exchange. Some have joined forces.

A second objective was to lay the groundwork for cooperative action. How well was it served? Well, IBM did tip its hat to Apple Computer for Apple's role in launching the personal computer, and Apple acknowledged the great products in multimedia beginning to appear from IBM and other companies. IBM agreed with others on the critical requirement for people to work together, and much was said about the need for unity of purpose, joint effort, and acting sooner rather than later. Participants were more than gracious in the admiration they expressed for each other, and especially for the work of the artists in attendance.

Yet, there were disagreements and discord too, with hints of hubris and disdain. It was only human, given the rich mixture of people. We should have expected it. But it was not exactly the atmosphere we intended. We wanted to create an environment of people trying to understand each other's different backgrounds and points of view. It was a great opportunity. What sometimes came across instead — when the voltage was highest — was a clashing of worlds and egos. (Some participants thought these clashes were the most interesting part of the meeting — true multimedia!)

We felt a little uneasy about this until having a conversation with Robert Lucky several months after the Roundtable. He had been looking at the edited version of the transcript, and generally liked what he saw. But he had one reservation: he thought the "immediacy" of an important verbal encounter in the session he moderated on business applications had been muted or

lost in the editing. He was right. We had worn kid gloves in dealing with the sparring match between Richard Lanham and Alan Kay on the importance of insights from other fields and times. Lucky, as moderator, seemed to have been annoyed with Lanham's comments. Since we thought the barbs might offend when printed on the page, we softened the words.

What Lucky told us in the later conversation is that he now wanted to do more reading. Despite appearances, he had been sensitized by Lanham's charge that lessons and analysis from the humanities and other fields were being neglected. Technologist Lucky had been ruminating on the matter.

We have since restored the harsh comments to the text. In the light of day, we now better understand the content of the disagreement. While it may have appeared at the time like a proverbial clash of cultures, it really wasn't that at all. Lanham was effectively saying, "Look, we humanists have something to offer. We've been thinking about these issues a long time." It may have sounded like he was putting down the technologists, but what he was actually doing was asking them to pay attention. He was not being an "intellectual Luddite" — bemoaning technology and damning its progenitors.[84] He was embracing the machine and expressing a desire to be party to how it was applied. He was asking to be heard in the only way that made sense to him. In his own words,

> *I didn't mean to diminish the importance of the computer revolution. Just the opposite — I wanted to point out how deeply rooted it really is in Western culture and how badly we need the past to understand this especially insistent present.*[85]

[84] C.P. Snow used the phrase, "intellectual Luddite" to refer to some of his literary friends "who simply deplore the introduction of the machine, while living off its profits; who regret the mechanical condition into which they were born, but take the fullest advantage of it." [C.P. Snow in Greenberger, *Computers and the World of the Future*, p. 5 (See Bibliography)]

[85] Letter from Richard A. Lanham to William G. Nisen, April 20, 1990.

There was another particularly caustic exchange at the Roundtable, this one in the session on education — a battle over "open" versus "common" architectures. The combatants were using the same phrases with different interpretations. The problem was, in part, one of semantics. In the exigencies of the moment, there was hardly time or inclination to define terms or examine intended meanings to ensure an orderly and dispassionate debate. So, again, the voltage rose. It was unintended theater.

Use of the phrase "common architecture" may have had a totalitarian ring to it, but no one acknowledged advocating a closed or proprietary system. There was basic accord on the desirability of full compatibility and intercommunication among platforms and systems, if not on how this might best be achieved. Question: is the goal consistent with the desire to achieve low-priced systems for homes and schools, or in conflict with it?

On such social and technical issues, there is latitude for honest disagreement. Argument can be an effective form of discourse. Once passions cool, there are grounds for working cooperatively.

Thus, although the second objective of the Roundtable was not met, there was little reason to expect it would be. What is important is that there were signs of a beginning. At the next Roundtable, we should be ready to focus discussion within subgroups on specific types of joint action and strategies for proceeding. We may even be ready to address constructively the troublesome matter of standards.[86]

Eliciting suggestions for action programs was the final objective of the Roundtable. Since recommendations were made individually, this was not as difficult an objective to achieve as the second. Many ideas surfaced. Most were proposals for cooperative action, which is what we wanted. A few

[86] Sanford Fisher has a good suggestion. Bring *buyers* together with sellers to discuss standards. They have the most to gain.

were thoughts on research or other programs that UCLA, the Anderson Graduate School of Management, or other schools and universities might undertake. These latter ideas, though not specifically what we were seeking, were interesting too.

Suggestions for Action Programs

• **Richard Lanham** projected revolutionary changes on the horizon resulting from electronic text and multimedia. He pointed to the need for universities to completely rethink matters of cost, space, and core curriculum, as well as how information is accessed and publication encouraged. But where in the university should such a review take place?

> *It's almost as if the compartmentalized university were designed to obstruct such a conversation. Either we will have to invent a new place for it, which I think is not unlikely, or we will use one that already exists. I would suggest three possibilities: (1) the library; (2) the writing or literacy program, like the one I started at UCLA; or (3) the business school. There are very different rationales for each alternative. But we have to start the conversation somewhere. I hope one of the action programs emerging from this meeting will be to suggest the wheres and the hows.*

• **James Catterall** urged a united effort to demonstrate the effectiveness of new media in the schools.

> *Schools do a thousand things now for kids, but not many very well. As Robert Winter said, "We need home runs, not singles." Let's get together to work on one front in a unified way. If we do it well, word of mouth will do the rest.*

• **Lucie Fjeldstad** commented that we need to crawl before we walk, walk before we run. She suggested a consortium of hardware and software vendors, schools, and universities, formed to take the best of what we've got — multimedia works like *Ulysses* and *Beethoven* — and make them into the right things educationally, one step at a time, until they are able to take root in the school system and grow. She had in mind education not only at grade school levels, but also in the university environment. She felt that teachers need to be instructed in not just how to use computers, but in how to change their way of teaching as their roles move from being purveyors of knowledge to being managers of the classroom. She emphasized that cooperative action would be essential. Well-designed prototypes are needed to encourage and allow the right people to work together.[87]

• **Tim Bajarin** appealed for an all-out missionary effort directed at educators.

> *We need to go out and deliver the message, showing the technology to schools and educators. . . . demonstrating what the technology is about. For the academic community, we might do this in an organized fashion at educational conferences.*

• **Reese Jones** had a "humble" proposal for serving the educational community.

> *Integrate the telephones, computers and video equipment that schools have today with inexpensive serviceable products that allow the faculty and students to create the content they know best. . . . Grade schools have PCs, Apple IIs, Macintoshes, VCRs, TVs, and telephones. Such equipment is easily integrated without major expense or new standards. Serve the educational community with products that solve its problems today.*

[87] From personal comments made by Lucie Fjeldstad to Martin Greenberger as she was leaving the Roundtable.

• **Jonathan Seybold** took a more aggressive stance that flies in the face of some deeply entrenched positions.

> *What we are trying to achieve is in direct conflict with the existing organization and practices of educational institutions. It is at odds with everything about the current educational structure. The suggestion that we try to adapt the technology to fit the way schools work may be reasonable, but I'd like to suggest a more radical, longer-term approach. I think we should rethink our educational institutions to take better advantage of the technology.*

• **Robert Abel**, seconding Seybold's motion for educational reform, volunteered an action program to involve the corporations.

> *We need the IBMs, Apples, Philips, and Sonys of the world — and other companies represented in this room — to step forward and say, "We want to support the work of the top talents of our time. . . . Someone must write letters to the companies. . . . I'll do it. . . . The time to take action is now."*

• **Jonathan Seybold** countered with a different approach for getting businesses involved.

> *What we don't have is a commercial process . . . by which a product can be created and sold. The problem may be that we are drawing our models from software, books, and films — which are pay-to-own or pay-to-use media — instead of from newspapers, television, and radio, where vendors pay to get information to consumers. . . . No advertiser is going to pay for a market that doesn't exist. The Anderson Graduate School of Management might help us break out of this chicken-and-egg dilemma. Until there is a real commercial process, multimedia developers may get their grants, but they are not going to have a business. Until there are people who want their products, want them to create these products, and are going to buy them, they will have to continue to go hat-in-hand demonstrating the concept.*

- **Mark Dillon** agreed.

> *I used to make films for Sunset Magazine. One thing I learned there was that the advertisements in the magazine were as valued by subscribers as the editorials. The magazine is clearly a medium for narrowcasting. There may be similar information niches for interactive media, where editorial content (as it were) and advertiser support can be commingled without getting users upset. . . . The Anderson Graduate School of Management put on this conference. Its comparative advantage may . . . be in helping us understand the marketing subtleties of multimedia.*

- **Hans Peter Brondmo** spoke of the need for an agreed-upon means of describing *content*, an overused term that, he implied, may not itself have much content at the present time.

> *We need ways of extending architectures and providing open-endedness, as discussed, but with content models that allow us to start sharing information produced for the end-user. I'd like to suggest . . . that the design of a suitable content model be the agenda for an action program coming out of this meeting.*

- **Jack Sculley** worried about the obstacles posed to small developers and to creative effort by having to secure property rights and raise funds.

> *To empower the creative talent in small firms as well as large, there will have to be a linkage among government, private industry, small producers, and the owners of content. I hope out of this meeting will come realistic plans for evolving structures to meet these needs.*

• **John Sculley** urged that the technology be moved out of the hands of technologists into the hands of the artists.

> *If the group here can do something to bring this about, then we will indeed have a chance to change the world a little.*

• **Bernard Luskin** wanted to see new educational programs launched.

> *Unless we get some professional school programs started in interactive product design, it will never become a professional field.*

• **Bob Stein** was not impressed with students coming out of existing programs in interactive design. He would go about it differently.

> *I would love to see summer institutes for professors and other people who have something to say, and who are passionate and excited about saying it in CD-I, HyperCard, or the multimedia systems coming out for IBM computers. Although this will take concentrated effort, it should not be too expensive. A coalition of IBM, Apple, and other companies with a few foundations could do something very interesting.*

• **Nolan Bushnell** made a recommendation that would have the shoemaker making shoes for himself.[88]

> *If we've really got such a very powerful communication medium, [we should apply it to communicate] the wish and promise of multimedia. It should be a group effort — with each of us putting in a certain part of our vision — for use at trade shows in presenting an overview.*

[88] "Him that makes shoes go barefoot himself." [Robert Burton, *Anatomy of Melancholy*.]

- **Nick Arnett** drew on suggestions made during the discussion.

> *In the legal area we could mount an effort to look at compulsory licensing. We could also promulgate the idea of attaching copyright and perhaps indexing information to data files. We could work on the problem of defining terms, so there's some standardization in their usage.*

- **Charles Firestone**, calling himself "an outsider looking in," presented a list of recommendations. First, was a proposal that cable-TV be considered a potential funding source for multimedia.

> *We've talked about television, we've talked about telephone, but no one in the entire meeting has mentioned cable — a broadband link into 55 percent of U.S. homes that for twenty years has promised interactivity. Some cable companies now in trouble might be interested in financing multimedia. But beware! They are not very farsighted in their outlook.*

Second, said Firestone, "We need a common language. We cannot even define what multimedia is." He was echoing the following reservations that others had expressed before him:

> The problem with the term *multimedia* is that it's at too high a level of abstraction. I don't know what it means. Is it a market? Is it a technology? *Television*, which connotes vision and communications at a distance, is more descriptive than *multimedia*. Maybe we don't have to change the name. Maybe it's just a question of learning what *multimedia* is as we start to experience it. . . . I prefer to call our subject *interactive media* to emphasize that we're *doing* something with the media. What makes interactive media exciting to me as a means for understanding is that it has the modeling capabilities of personal computers, along with the watchability of television, plus one other thing — we *do* something. **(John Sculley)**

Interaction and multimedia are two very different ideas, although we seem to be using them synonymously here.[89] **(Jonathan Seybold)**

We don't like to call it *multimedia*. We prefer *mutual media*. **(George Coates)**

I don't like the term *multimedia* either, but I haven't got a better one. What amazes me is how much excitement has been generated in the marketplace with the integration of voice and visualization — effects that appeal to only two senses. I contend that multimedia properly defined is really *sensory computing*. **(Michael Quinlan)**

I cannot think of a simpler two-word definition for multimedia than *sensory concurrency*. Such concurrency can consist either of related or unrelated activities. For an opera, which is certainly multimedia, the concurrent activities are clearly related. . . . Yet the future is with concurrency where media activities are unrelated, where you look at a picture and simultaneously talk about something which may have nothing at all to do with the picture. **(Nicholas Negroponte)**

The key to *multimedia* is not the media part, but what *multi* really means. To me, it doesn't mean lots of media. It means lots of dimensions. What we should be talking about are the dimensions the computer provides that no other physical entity can have. **(Alan Kay)**

[89] The point was echoed in a letter from George Rebane to Martin Greenberger, dated March 30, 1990, a few days after the Roundtable. "Many of the participants did not realize that *multimedia* and *interactive* have orthogonal meanings. . . . As far as market acceptance is concerned, the clever use of high quality multimedia will not save a dialog with poor interactive design, but a good interactive design will more often than not overcome the shortcomings of a mediocre multimedia production. . . . I believe solution of the *interactive* design problem continues to be the key to successful dialogs and (single medium) interactive applications. The interactive designer must, above all, be able to inject a vicariously functional copy of himself into the unattended machine so that it can carry on a useful conversation with untrained individuals using whatever media the system can command."

The final item on Firestone's list, which he called "the most important" and "obviously the hardest," was developing "people with imagination." We took the cue to ask Jack Sculley, a young man with imagination, to reflect on his experiences in starting a small production company and in finding funds for his multimedia project, "The Mars Explorer." This is the way Jack responded several months after the Roundtable.

■ Jack Sculley

The problem in getting high calibre content people involved with multimedia is complex and multifaceted. What, after all, is a *content provider*? How does one go about establishing a *content-providing* firm?

The vast majority of top-quality content people are specialists residing in tenure-based institutions, who survive on their ability to produce books and articles — finished product. These people, trained to think linearly and narrowly, are expected to provide the maximal output. "Publish or perish" is the code. Fortunately, many of these great minds do think about the relationships between their work and that of others — the connection to the cultural fabric as a whole. They are well-disposed to adopt some form of interactive medium as a vehicle for expression.

Even more approachable are the talented *content people* in less rigidly structured institutions; for example, in the media field. But they must be targeted effectively, and offered compelling reasons to undergo the intense agony of getting their "feet wet" in multimedia. In particular, they must be provided with an effective distribution channel for their work, so they will not have to take out a fifth mortgage or win the lottery to get along in the field.

Indeed, content *is* a problem. We don't even have a workable definition for it. People constantly confuse whether the term refers to raw data or finished, authored material. *Content* is used to refer to unstructured collections of

information, like a loose pile of film cuttings, and also to finished interactive-media products, such as Voyager's disc on *Beethoven's Ninth Symphony*. Some say *content* is every available piece of information on every related topic in a particular area; others, that it's whatever the author defines it to be. Is a *content person* an established expert in a particular field, a skilled communicator of ideas, an instructional designer, or a holder of a license to certain key bits of information?

To identify and support content people may require overcoming the compartmentalized, esoteric knowledge that traditional institutions promote. Robert Winter and Richard Lanham envision a political battle to be fought in the universities to make information widely available in interactive and interdisciplinary formats.

Extremely talented scholars, both living and dead, have written much which could enrich interactive media. Since they are not thought of as being "technically literate," their contributions are often ignored or denigrated. Many scholars and artists discount computer-based media as a viable outlet, because they view it as trivializing weighty matters and according *hackers* respectability, encouraging low quality output appealing to the masses. Most threatening may be the fact that interactive multimedia removes control and ownership of the end product, placing it in an easily editable and reproducible form.

Let me speak from my own experience in producing *The Mars Explorer*. First is the impossibility of creating a finished product which is both technologically up-to-date and informationally complete. It's like Einstein trying to ride a photon. Fundamental properties of matter and space-time expand and recede as one approaches the speed threshold. So, for us, did multimedia project parameters like budget, target-date, and distribution channel, as we attempted to keep up with the prodigious rate of technological change. No sooner had a new technology been implemented in our design than it

(Jack Sculley)

became obsolete, or another "must-have" capability was announced. Freezing the technology to focus on content may seem sensible, but could result in multimedia backwater — the kiss of death in an industry environment which prizes technological razzle-dazzle over thoughtful, reflective treatments of content.

Think about who the funders and evaluators of most interactive media projects are: Apple, IBM, and the rest of the hardware/software folks. They want displays which boost their products. Yet, they generally don't spend a lot of time making their technology amenable to intense exhibiting and experimental interaction. The result is we must spend too much time fixing crashes and correcting glitches. Investment is not yet coming from outside sources focused on quality content and treatment.

Next there is the problem of trying to make products *informationally complete* by including all (or most) relevant content. The truth is that an interactive media project is never really finished. It's at best in a temporarily induced state of stability. We cast our nets and sieve out the fish which fit nicely in the mesh. To catch different fish, we must reweave the mesh, allowing some kinds of the previously caught fish to slip through. We have to let them go. Since there is no all-size net to fit every known fish (i.e., every item of information), we may end up with a hodgepodge in our net from the user's point of view.

We need, instead, to provide users with tools that allow them to fashion the nets to their own liking. But the fish may belong to somebody else. We are allowed to catch these fish only if we recognize their owners with praise or money. This requires some way to establish the identity of the owners. The problem is that there may be a nearly infinite number of fish species, and the fish may be mutating and crossbreeding into new, barely recognizable forms.

Nevertheless, unless constructive measures are taken soon, the thorny issues of copyright, intellectual property, and repurposed information may scare many would-be *multimediators* from the industry, leaving it to the people with content and to the owners of the copyrights.

As we move from the demo to the completed product, we discover to our horror that there is no one with the cash or equipment to buy our product, and no one to market it. I am repeatedly asked whether our work is destined for software stores, book stores, record stores, or educational resellers. My response is "all-of-the-above" and "none-of-the-above." We are willing to sell through whatever channels are available to us, but realize that none of those in place are yet effective.

This is no reason to throw up our hands and make documentaries about rare jellyfish. The industry both *wants* and *needs* pioneering projects, but for different reasons. It *wants* them to show off new hardware and software. It *needs* them to expand the envelopes of technique, technology, and customer appeal. Yet the companies in the industry make unsuitable funders.

Nor can the consumer market at this point support worthy projects. Then, who will fund them? How can a content-providing company pay for itself and the imaginations it develops — the Robert Winters it jump-starts?

When the commercial sector cannot — or will not — fund meritorious projects in the public interest, foundations often pick up the slack. Our multimedia project promotes science education. Thus, the National Science Foundation was an inviting target. But NSF's conservative peer-review system does not favor futuristic, unconventional media projects. Knowledge about interactive media has not yet percolated into the minds of most NSF reviewers. An expert in any established field will have a natural reluctance to learn about new experimental fields.

(Jack Sculley)
Thus, we had the double challenge of educating the Foundation on the advantages of interactive media, and selling our particular topic and treatment. It's difficult communicating with a large organization. We had to have personal conversations. If participants at the Roundtable would all become evangelists for the field, the job would be easier.

Government might seem a likely source of funds, but to show how far it still has to go, let me paraphrase from a recent solicitation by an unnamed government agency.

> Innovative software is required that: (1) utilizes interactive CD-ROM technology for use with school computers, including the IBM PC, Apple II GS, and Apple Macintosh. *(Videodiscs need not apply, as they are obsolete.)* (2) provides an implementation easily adaptable to the handicapped, to minorities, and a range of student levels (*in one package*!)[90]

Meeting all these requirements could so water down the product that no student would want to use it. Cross-compatibility alone gives my software engineers the shakes.

Most foundations and government agencies require educational developers to conform to present curricular structures. This is like trying to conduct fusion in Tupperware. Since interactive media are anathema to established curricula, demonstration products usually collect dust on a classroom shelf. Should we rework the curriculum to allow for multidimensional, multidisciplinary pursuits, or constrain our product to fit established norms? When the arbiter is the conservative institution with our proposal in-hand, it takes guts to hold out for the former.

I know I've painted a rather bleak picture, but look at the exciting things happening anyway. Robert Winter and the Voyager Company were able to

[90] Italicized words were added by Jack Sculley.

produce *Beethoven's Ninth*. Robert Abel and IBM made *Ulysses*. ABC News came up with its *Instant Replay of History* line. And smaller companies with only marginal institutional affiliations are winning grants, investments, and contracts. Imaginative authors are coming to the fore despite the obstacles. It takes persistence, cleverness, and, as always, a little bit of luck.

Other Viewpoints

Another viewpoint on the best way for imaginative people to secure financing came to us earlier in a letter from **Ed Belove** of Lotus Development Corporation.[91]

"During the Roundtable, there was a minimum of discussion about the evolution of multimedia into the commercial, profit-making arena. Some would leave development to the artists. This is fine as far as it goes, but multimedia as art will be supported the way art in all the other media has been supported — irregularly at best.

"I believe channel availability is not the major bar to commercial success some suggested it was. The issue is having the right products. Selling multimedia products will not be too different from selling software and records once we have products that appeal to real customers.

"*Pong* and MTV were mentioned as analogous new concepts that, for some reason, were simpler to instantiate. This is true, but it's because both of them were based on well understood commercial transactions. The advantage was clear to both buyer and seller. This is just not so for *Beethoven* or *Ulysses*, as attractive as they may be.

"One way of increasing the audience for these products is by taking them to teachers and explaining how they make teaching easier and better.

[91] Edited from a letter dated July 2, 1990, from Ed Belove to Martin Greenberger.

(Belove)

"Another way is by applying the same techniques and talents to projects for which there already is an audience in place. I contend it is better to design a product for an existing audience, rather than to have to convince people they should be interested in an existing product.

"One obvious example is in training. Every year billions of dollars, yen, and francs are spent to purchase training for personal computers and their software. Multimedia is starting to be applied to this effort, but without the level of insight demonstrated by the examples shown at the Roundtable. I believe that if we can make the poem *Ulysses* or the painting *Guernica* more approachable and understandable through the creative use of multimedia, we can teach people to use dBASE III or Lotus1-2-3 far more effectively.

"By applying some of the talent pool to commercial endeavors, we can multiply the usage of multimedia hardware and software. Like any other business, increasing the usage will decrease the cost and bring pricing to the point where limited-interest products will be able to attract a critical mass of potential buyers, making a whole new range of products commercially viable.

"Unless and until we aggressively bring the technology to existing markets, rather than finding people to bring to the technology, multimedia will remain what it is today — an exciting curiosity at the edges of standard usage."

More on the business perspective came from **Michael Quinlan**, who spoke with us after the conclusion of the Roundtable.[92] Quinlan has since become a senior fellow, on leave from IBM, with the SEI Center for Advanced Studies in Management at the University of Pennsylvania's Wharton School. At the

[92] Edited from personal remarks made by Michael Quinlan to Martin Greenberger, March 27, 1990

time he was preparing for a presentation on multimedia that he and Lucie Fjeldstad would soon be making to IBM chairman John Akers. This presentation would lead to the formation of a new division at IBM in Multimedia and Education.

"I feel the industry I'm part of will be changed dramatically in the 1990s by the multimedia paradigm shift, just as it was by the personal computer in the 1980s.

"What I find at a conference like this is the remarkable innovation and creativity flowing into the industry from a variety of sources. Drawing on work I did in Japan, I'm interested in determining how to ally my company with the growing number of small companies, without changing them. You can't prosper in Japan without partnerships and alliances.

"The answer is not to *buy* the companies. That would give us too much control and, over time, make the small companies like us. What we want is influence — a gear box, where we can bring our strengths together with theirs.

"Small companies can react quickly. They are free of bureaucracy and demonstrate remarkable innovation. Large companies have the capital and staying power required for an innovation to mature in the marketplace. They can give credibility to an idea just by endorsing a product. These two sets of strengths complement each other perfectly.

"In my world, we don't have debates any longer about standards. The standards are being set quite nicely. As far as I know, no one in this industry speaks about proprietary platforms any longer. It's unacceptable to the customer base. What we have are just different ways of applying the same technology.

(Quinlan)

"Like others, I hate the term *multimedia*.[93] It doesn't convey enough. Today, it's primarily a combination of audio and a variety of visualization effects. Potentially, it has to be much more. What limits the spread of technology most is the fact that it's still too difficult to use. Only a handful of the population is actually using this incredible microprocessor technology that could benefit so many.

"The interface between human and computer must be made much more natural. We want to engage people with all of their senses. When we communicate with each other, we look, we see, we listen, we talk. Occasionally, we'll tap someone on the shoulder. The act of touching is also a means of communication.

"As multimedia gets defined more broadly, it will be thought of as processing with the senses. Today, we see and hear the computer. Within a few years we'll be talking to it, touching it, and using our finger and pencil instead of the mouse and keyboard as primary input devices. The computer will become a much more natural vehicle for communication. The way we talk to it will be the way we talk to a fellow human being — with our senses. Then this marvelous technology will benefit all of us, not just a small minority."

Michael Ester, director of the Getty Art History Information Program, had planned to be at the Roundtable, but was not able to be there. We asked him to relay his perspective on recent events unfolding in the visual arts and electronic media.[94]

"I recently returned from SIGGRAPH 90. Certainly one of the most striking events was the Computer Art Show. While the convincing realism of modeling and texturing had a powerful impact on specific pieces,

[93] As pointed out earlier in the chapter, Quinlan prefers "sensory computing."

[94] Letter from Michael Ester to Martin Greenberger dated 8/22/90.

technical effect in itself did not qualify submissions for acceptance. What the art committee was looking for was content. A strong message in this year's show is that artists are moving well beyond tour-de-force technology, and are exploring challenging ideas and aesthetics. Themes both personal and social are finding strong visual expression.

"A quality I was looking for in particular is appearing only gradually. Computer art as a distinct medium provides an extraordinary opportunity to express new visions of place and time. Currently, the viewer will more often see the static result of the artist's process in two- and three-dimensional objects. However, lurking back in the computer is often an electronic world complete with imaginary environments, objects, and characters. These come complete with dimensionality, texture, movement, and often, personality. That these worlds are so completely malleable, that they can be animated and alive within their own sense of time, and that they can be infinitely revisited and experienced is one of the truly remarkable features of the computer art medium.

"Compare this with photography, which in its recent history is perhaps most closely associated with computer graphics. The camera freezes a moment in time. The same visual circumstances can be recreated, but the photograph remains bound to an event. Whatever the presentation medium, the internal computer world continues to exist, and the more this internal continuity and vitality is experienced by the viewer, the more a unique contribution of computer art is realized. How can the computer artist share this world?

"There were several examples in the Computer Art Show that give some sense of this world. Interaction with the viewer is certainly one way. Nothing conveys the sense of dynamism more than the ability to change and react to the environment, often in several media at once. However, submissions of interactive pieces still remain too few in number."

Afterwards

Multimedia was in the fast lane in the months following the Roundtable. Not to be outdone by the smaller firms, the giants of the industries represented at the Roundtable pushed forward aggressively to lay claim to their parts of the field. Jan Timmer, the new chairman of the board of Philips, declared that CD-I and HDTV would be among the company's highest priorities for the next century.[95] Intel reported that PC manufacturers would be using its chips to put the DVI technology onto the motherboard starting in 1991. Commodore International, introducing Commodore Dynamic Total Vision (CDTV), an interactive multimedia player for the home consumer, announced it was hiring Roundtable participant Nolan Bushnell as general manager of its new Consumer Interactive Products division.[96]

Meanwhile, Apple Computer unveiled the eagerly awaited HyperCard 2.0, and stressed a belief in the importance of integrating sound with text. Indications were that Apple's new computers would have the capability for sound recording and compression built-in. Apple also formed an alliance with the film industry, establishing a working relationship with the American Film Institute in Hollywood.

Some time after the Roundtable, Bob Abel resigned as president of A.N.D. Communications, Inc. and formed Synapse Technologies, Inc. He is now developing *Columbus/The Discoverers*, a large educational project with IBM. IBM has also funded Allen DeBevoise and Morgan Newman at A.N.D. Communications, Inc. to complete production of *Ulysses* and *Guernica* so they can be in schools by Fall of 1991.

Three months to the day after the Roundtable, IBM made two major announcements: (1) the PS/1 computer for the home market and (2) its new

[95] Statement made by Jan D. Timmer, in his keynote address at a conference on Interactive Multimedia in London, June 1990.

[96] *The Videodisc Monitor*, Jul-Aug., 1990, Vol VIII, p. 1, *Commodore Unveils CDTV: Bushnell heads New Interactive Division.*

Multimedia and Education Division to be headed by Roundtable participant Lucie Fjeldstad. In announcing the new division, IBM repeated the sanguine prediction it had made at the UCLA meeting.

> *Because multimedia — that exciting marriage of enhanced personal computer capabilities and creative applications involving sight, sound and touch — breaks down language and other barriers to learning, we believed it could bring something important to the table as we looked for ways to "get at" the human capital crisis. . . . [We] began developing a multimedia strategy. . . . [We believe that] multimedia will be to computing in the 1990s what PCs were to computing in the 1980s.*[97]

Apple and IBM chose Digital World, a large affair conducted in Beverly Hills by Seybold Seminars, as a platform for their announcements. Many Roundtable participants were on the program at Digital World. Bob Abel and Lucie Fjeldstad did a "Bob and Lucie" show, teaming up to show *Ulysses*. Robert Winter, in demonstrating his work on the *Ninth Symphony* and *The Rite of Spring*, acknowledged putting 1800 hours into Beethoven and 1100 hours (so far) into Stravinsky. ("But who's counting?") James Catterall commented on the close match he saw between the potential of multimedia technology and the different ways kids learn. Reese Jones gave a tutorial on digital telecommunications, Max Whitby described the use of computerized guides in multimedia productions, and there were talks by Mark Dillon, Rob Glaser, and Steven Mayer.

Mayer's firm Digital F/X was planning an October 1990 ship date for Video F/X, a professional-quality video production system.[98] Max Whitby was

[97] Statement by Lucie Fjeldstad's office, July 1990.

[98] "Digital F/X Rolls Out Desktop Video," Connie Guglielmo, *MacWEEK*, 7/31/90, Vol. 4, No. 26, p. 6.

concluding an agreement with MacroMind to make commercially available, also in October, his MediaMaker software for assembling multimedia presentations containing graphics, animations, video, and digitized sound.[99]

In an interesting Digital World session on content and intellectual property, Bob Stein mentioned that it did not occur to him seven years ago, when he was setting up the Voyager Company, that he would be spending so much of his time worrying about copyright problems. David Nimmer pointed out that the rules underlying copyright regulation are culturally dependent and not ineluctable. He continued to promote the idea of using the compulsory license framework to deal with copyright problems associated with the new media, while suggesting that a paradigm shift in copyright law may be imminent. Whereas copyright law and its enforcement are currently based on a model of absolute property rights, they could be guided in the future by a model more consistent with harmonious relationships among parties — along the style of the Japanese.

Nimmer will develop a position paper on these and related issues for the second Roundtable, planned for April 1–2, 1991. The theme of the meeting will be Content, Compatibility, Communications, and Copyright, central sets of issues coming out of the first conference. Several action programs may be ready for launch by the time of the second meeting. Stay tuned.

[99] "MacroMind's MediaMaker to make expo debut," Connie Guglielmo, *MacWEEK*, 7/31/90, Vol 4, No. 26, p. 14.

Terms, Concepts, and Abbreviations

ACTV
An entertainment-oriented interactive pay cable service being tested in Springfield, Massachusetts and Montreal, Canada. Commercials are targeted to subscriber interests based on information stored in the convertor. Subscribers enter responses on a four-button remote control, thereby selecting from among two- or four-frame synchronized audio and video signals transmitted simultaneously into the home along with computer commands imbedded in the vertical blanking interval.

Algorithm
A predetermined set of instructions for solving a specific problem, such as drawing a line or compressing a digital image, in a finite number of steps. A plan of the exact sequence of steps needed to accomplish such a task.

Artificial Intelligence
A technology and set of techniques for imparting to the computer the appearance of understanding natural language, learning from experience, and otherwise exhibiting goal-directed behavior. More broadly, a cognitive science that delves into the nature of language and learning using a methodology rooted in information processing and computer modeling.

ASCAP
American Society of Composers, Authors, and Publishers

ASCII
(ASS-kee) American Standard Code for Information Interchange, a standard seven-bit code transmitted with parity bit, for a total of eight bits per character. Established by the American National Standards Institute to achieve compatibility among different equipments, it is used internationally to code alphabetical and numerical characters and other symbols into binary values for processing and transfer.

Aspect Ratio
The ratio of width to height of a picture or video image. In conventional broadcast television, the ratio is 4:3. Larger aspect ratios considered for High Definition Television provide a more elegant appearance resembling the wide motion picture screen or the two facing pages of an open book.

Band
A range of wavelengths or frequencies.

Bandwidth
A measure expressed in hertz of the range or band of frequencies near maximum power levels (or amount of information) a communication line or component can transmit, encode, or decode. The difference between the limiting frequencies of a continuous frequency band. Video requires a wider bandwidth than audio. The bandwidth of a TV channel is 6 MHz.

Bit
A *binary digit* represented by 0 or 1 in the binary number system. The smallest unit of storage in the computer. Groups of bits form *bytes* and *words*. Microprocessors can handle either 8, 16, or 32 bits simultaneously.

Bit Stream
A sequence of related bits transmitted over a communication line with no separations between character groups.

BMI
Broadcast Music, Inc.

Broadband
A synonym for *wideband*. A communication channel having a bandwidth broader than that of a 4 kHz voice-grade channel, thereby providing capability for high-speed data transmission.

Broadcatch
The content-specific selection and repackaging of information at the receiving end. The opposite of both *broadcasting* and *narrowcasting*. [Brand, p. 42]

Glossary

Byte
A string of generally either 6 or 8 bits. The smallest accessible unit of information in computer memory.

CAV
Constant Angular Velocity. In optical disc storage systems, a drive that keeps the speed of rotation constant and synchronized to the television vertical frequency, thus making random access easier but reducing storage capacity by virtue of the higher rotation speed required. LV-CAV records 30 minutes of video per side. See *CLV* and *LV*.

CCITT
Abbreviation for *Comité Consultatif International Téléphonique et Télégraphique*, an international committee providing standards for data communication among countries. CCITT V.24 is a set of standards in data communications specifying such interface characteristics as the functions of the pins of a connector. See *RS-232*.

CD-DA
Compact Disc–Digital Audio. The 12-cm (4.75 inch) laser-encoded optical read-only disc originally introduced to the consumer market as a storage medium for digital audio, and since extended for use with digital data and digital video.

CD-I
Compact Disc-Interactive, a CD format and interactive computer system developed by Sony and Philips for the digital storage and playback of audio, data, still graphics, and limited motion video. The technology has been designed for use by consumers on television sets.

CD-ROM
Compact Disc Read-Only Memory. A CD with the same constant linear velocity (CLV) spiral format as compact audio discs and some videodiscs, holding about 550 megabytes of digital data.

CD-ROM XA
An extended architecture format for CD-ROM.

CLV
Constant Linear Velocity. In optical disc storage systems, a drive that adjusts the speed of rotation depending on the position of the track on the platter, so that track velocity under the reading head remains constant. This provides maximum storage capacity (an hour of video per side), but does not allow the random access to each frame that *CAV* does. See *CAV* and *LV*.

Common Architecture
Based on a standard format. See *Open* and *Closed Architectures*.

Compressed Audio
The digital encoding of up to 40 seconds of voice-quality audio per individual disc frame, resulting in a potential for over 150 hours of audio per 12-inch disc. Audio information accompanying a still-frame image is known as *still-frame audio*.

Compressed Video
A video image or segment digitally processed using computer algorithms and other techniques to reduce the amount of data required to accurately represent or transmit the content. The space required to store that content.

Compression
A digital process that allows data to be stored or transmitted using less than the normal number of bits. Reduction of a signal's amplitude or duration to improve transmission efficiency and reduce storage needs.

Content
The story, music, game, text, animation, movie, show, presentation, or mixture of these elements that forms the substance of a multimedia production. Developing concepts and creating content is the work of authors and artists.

CPU
The Central Processing Unit of a computer system where calculation and information processing takes place.

DAT
Digital Audio Tape. A medium for storing music with high fidelity, resisted by the recording industry because of the ease with which tapes are reproduced.

dBASE
Software by Ashton-Tate for organizing and managing computerized databases, with features for data entry, data query, and the generation of reports.

De Minimus
Trifling or insignificant, as used in the law. *De minimus non curat lex.* The law does not take cognizance of trifles.

Desktop Publishing
The preparation of publications with the personal computer. See *PageMaker.*

Digitizing
Conversion of an analog signal or image to be scanned into a digital form that can be stored, processed, and displayed by computer.

Director
Software by MacroMind for animation and three-dimensional rendering of graphics. The successor to MacroMind's VideoWorks II.

Disc, Disk
Generally, a flat round object — from the Latin word "discus," the Greek "diskos," and the French "disque." In the 1933 edition of the Oxford English Dictionary — before either data disks or videodiscs had appeared — "disk" was the primary spelling, although "disc" was accepted. By the time of the 1972 supplement, "disc" had become the primary spelling, with phonograph records as one of the definitions. In 1985, "videodisc" was given as one word. Common usage today dictates that when it is optical storage, it is a "disc"; when magnetic, a "disk."

DOS
Disk Operating System. Also called MS-DOS and Microsoft DOS after the company that produced the software. DOS is the basic operating system for the IBM PC and the family of IBM compatible computers. Its familiar symbol is the A> prompt.

DVI
Digital Video Interactive, a format and technology that allows real-time compression and decompression of graphics and full-motion video for recording on CD-ROM, videodiscs, magnetic disks, or other digital storage media. Developed by RCA's David Sarnoff Research Center, the technology was sold by GE to Intel after GE took over RCA in 1986. First shown publicly on March 1, 1987 at the Second Microsoft CD-ROM Conference.

Dynabook
A hand-held stand-alone interactive-graphic computer for school children, with painting, communication, animation, and game-playing capability, all for under $500, as envisioned by Alan Kay at Xerox PARC in the early 1970s.

EIA
Electronics Industry Association.

Encryption
The process of encoding data to make it difficult to understand or decipher without proprietary software or hardware, thus providing protection from unauthorized access.

Ethernet
A high-speed network protocol for the distributed packet switching of computer data in local area networks, developed by Robert M. Metcalfe and D. R. Boggs at Xerox PARC in the 1970s.

Glossary

Fair Use
The use of copyrighted material — or parts of copyrighted material — for a purpose that does not infringe on the rights of the owner as protected by the copyright. Quoting from the material or critiquing it could be examples.

FDDI
Fiber-Distributed Data Interface.

Fiber Optics
The technology of transmitting data represented as signal-encoded light beams by total internal reflection through waveguides consisting of thin filaments of glass called *optical fibers.*

Full-Duplex
A communication connection in which messages can flow simultaneously in both directions.

Full-Motion Video
The playing of NTSC signals at 30 frames a second or PAL signals at 25 frames a second.

Gateway
A videotex system introduced by the Times Mirror Company in Southern California in September 1984. Like its predecessor, Knight-Ridder's Viewtron service, Gateway was unable to amass a sufficient subscriber base to stay viable. Neither of those systems used personal computers in their initial version, opting instead for a specialized terminal called *Sceptre,* costing $600 to $900.

Graphical User Interface (GUI)
A mouse-driven user environment for the personal computer that includes features such as windows and icons on a bit-mapped display. See *Macintosh* and *Windows.*

Hard-wired
A terminal directly connected to the computer, or a device with permanently wired circuitry enabling it to perform a fixed set of operations. Contrast with *programmable.*

Hertz (Hz)
A unit of measure also called *cycles-per-second.* MegaHertz (MHz) is *millions of cycles-per-second.*

High-Stakes Testing
Tests such as the California Assessment Program and other statewide activities that examine children at three or four grade levels each year, and publish the scores by school.

HyperCard
An object-oriented programming system for the Macintosh computer developed by Bill Atkinson. HyperCard uses scripted messages, user-added commands, an English-like programming language called HyperTalk (designed by Dan Winkler), and virtual cards with automated fields and buttons to provide broad interactive functionality, including animation, fast search, special effects, and drivers for audio and video.

Hypertext and Hypermedia
Hypertext is a system for building up text electronically, allowing it to be viewed in arbitrary (nonlinear) fashion while moving from one association to the next. Hypermedia generalizes the concept to other forms of media, including stores of pictures, sound recordings, and video.

I-386
The Intel 80386 microprocessor, used by high-end models of the IBM PS-2 line of computers.

Interactive Multimedia
User control of sound and video by means of computer, often at the desktop. More generally, using the computer to integrate sound, video, and animation with text and graphics. Someday this integration might involve using, if not the full sensorium, significantly more of the sensory apparatus.

Interactivity
In the everyday sense, interactivity is open-loop control, where a programmed system is directed by its user. More strictly, it is an

ongoing conversation between system and user. Mutual and simultaneous activity where both participants may be working toward a goal, where either can interrupt the other without crashing the operation, there is limited ability to anticipate, no default path, and there is the impression of an infinite database. [Brand, pp.46-50]

Interface
The means of interaction between two devices or systems that handle data by different codes or formats. A shared boundary or storage buffer between two devices, systems, or programs. The environment presented by a personal computer to its user.

Interlace
The use of two vertical scans or *fields* in the *scanning* of a television image. One field contains the odd lines of the frame, the other the even lines.

ISDN
Integrated Services Digital Network. A digital telephone network under discussion for many years nationally and internationally. The network is designed to carry all forms of data, including digitally encoded voice and video. An ISDN channel is end-to-end digital at 144-kilobits-per-second, divided into two circuit-switched 64-kilobit-per-second channels (B channels) and one 16-kilobit-per-second packet-switched channel (the D channel). The network has been long in coming due to the difficulty of agreeing on standards, and the time required to replace the massive telephone plant with optical fiber and digital switching.

ISO
International Standards Organization, a group concerned with promoting the adoption of protocols for data communication and other standards. See *OSI*.

JPEG
Joint Photographic Experts Group, an ISO/CCITT international standards group developing a standard for compression and decompression of still-color images.

Laser
An electromagnetic source capable of producing infrared and visible light.

LED
Light-Emitting Diode. A solid-state device that emits light when a current is applied, providing a fiber optic light source.

Linear
A term used to describe a medium such as a book or film which is constructed to be read or viewed in sequence from beginning to end. Contrast with *Hypertext* and *Hypermedia*.

Local Area Network
A general-purpose communications network that provides interconnection within a small area for a variety of data communication devices, including terminals, microcomputers, and minicomputers.

LOGO
An interpretive programming language with which school children learn by interactively directing the motion of an abstract or synthetic turtle. Developer Seymour Papert was strongly influenced by the ideas of Jean Piaget,with whom he worked in Switzerland for five years. Papert began thinking about a computer language suitable for children in 1967. LOGO is now a powerful system and a family of languages.

LV
LaserVision video disc. A read-only analog system that stores motion video and audio on a 12-inch optically recorded disc. This technology, used for interactive video because of its fast random access, preceded CD-DA and CD-ROM technologies by several years. See *Video Disc*, *CAV*, and *CLV*.

Macintosh
A family of Apple computers, extending from the black-and-white Macintosh Plus and Macintosh SE on the low end to the color

Macintosh II computers on the high end. Patterned on features incorporated in Xerox's Star and Apple's Lisa, the Macintosh is the first computer to offer a *graphical user interface* (*GUI*) to a broad class of users.

MIDI
Musical Instrument Digital Interface. A serial digital bus standard widely used in the music industry for controlling and interfacing digital musical instruments.

Minitel
A videotex system developed and funded by the French government that has had surprising success in France. Minitel is the name of the terminal used.

MIPS
Million Instructions Per Second.

Modem
A hardware convertor for changing between digital computer data and analog tones suitable for transmission over a dial-up telephone network. Conversion is possible at rates of 300, 600, 1200, 2400, 4800, 9600 or 19,200 bits per second, depending on the modem.

MPEG
Motion Picture Experts Group, an ISO/CCITT international standards group developing a standard for digital storage and transmission of motion, video, CD-quality audio, and control data, at CD-ROM bandwidth.

Multimedia
In the narrow sense, control of sound and video by means of computer — usually, but not necessarily at the desktop. More generally, the computer integration of sound, video, and animation with text and graphics. See *Interactive Multimedia*.

Narrowcasting
A term coined by J.C.R. Licklider in 1968 (in a Carnegie report that led to the founding of PBS, the public television channel) to mean programming targeted at specific audiences. Examples would include a brokerage firm sending advertisements to investors, or a toy firm to households with children. The term is meant to stand in contrast to *broadcasting*, where the transmission of information is scattered. See *QUBE*.

Needle-Drop Music Library
Pre-recorded public-domain material.

NeXT Computer
A future generation computer system conceived by Steven Jobs after leaving Apple Computer, and the company of the same name he formed to produce the system.

NTSC
National Television System Committee, the standards group that created the U.S. color television standards in 1953 called the NTSC color television system. See *PAL*.

Object-Oriented
A style of programming in which programs are structured in terms of entities called *objects* in space and time, such as the buttons and fields of HyperCard. Objects are characterized by their state, the actions they perform on other objects, and the actions that can be performed on them.

OEM
Original Equipment Manufacturer.

Open and Closed Architectures
The degree to which a design is hospitable or inhospitable to other kinds of equipment than the one for which it was conceived.

Open Loop or Open System
In process control, a semi-automated system that allows or requires the intervention of a human operator.

Optical Fiber
Flexible strands of glass or plastic through which laser beams or light from LEDs are passed to transfer data. The strands formed into cables can carry many times more

information than traditional copper wire. The SONET standard for optical transmission calls for a standard rate of 2.4 gigabits per second.

OSI
Open System Interconnection - a model for data communication that defines seven layers requiring protocols. The application layer, such as electronic mail, is at the top; the physical connection of modem to computer is at the bottom.

Packet
An original set of bits grouped for transmission with source and destination addresses stored along with the data to be sent.

Packet Switching
The transmission of messages subdivided into short packets, via a communications network containing many computer nodes for routing the messages. Generally quicker and more efficient than traditional message switching.

PageMaker
Software by Aldus Corporation for using the personal computer to do work at the desktop traditionally done in typesetting, layout, and pasteup. PageMaker and Aldus have been pace setters in the field now known as *desktop publishing*.

PAL
Phase Alternation Line, a key feature of the PAL color television system developed in West Germany and used in many European countries. See *NTSC*.

Peripheral Device
A component of a computer system — such as a tape drive, disk drive, terminal, or printer — used for information storage or input/output operations under control of the CPU.

Postscript
A font technology developed by Adobe Systems used with PageMaker and Apple's Laserwriter printers for desktop publishing.

Prodigy
A videotex system developed over several years through the joint effort of IBM and Sears Roebuck (partner CBS withdrew) and now actively marketed in major cities throughout the United States. See *Videotex*.

Programmable
A device whose operation can be controlled by computer program. Contrast with *hard-wired*.

Protocols
A set of rules for communicating between devices, specifying, for example, how information is addressed, sent, received and read over a network.

Pulse Code Modulation (PCM)
The use in telephony of digital signals to encode analog data, such as voice. PCM is based on the fact that a signal sampled at regular intervals of time at a rate higher than twice the highest significant signal frequency may be reconstructed from the samples by the use of a low-pass filter.

Px 64 (P times 64)
A telecommunications compression standard use in video conferencing.

QUBE
A system of two-way cable introduced by Warner Communications with much fanfare during the 1970s to provide information, entertainment, and transactions capability to the home. The system included a facility for *narrowcasting* that promised advertisers more focused targeting of customers, while promising customers material fashioned to their own particular interests. Though seen at the time as the start of a new age of cable *interactivity*, the system was not a commercial success. See *Videotex*.

RGB
Red, Green, Blue — the basic color components of a television signal.

Glossary

Rheostat
A continuously variable electrical resistor used to regulate current.

ROM
Read-Only Memory. A memory chip that can be read but not written or otherwise altered after manufacture. ROM provides permanent storage for program instructions and is used by microprocessors that always execute the same program.

RS–232
In data communications, a set of standards adopted by the EIA and widely followed by hardware manufacturers. The standards specify various electrical and mechanical characteristics for interfaces between computers, terminals, and modems, including an interface consisting of 25 pins or leads, each of which is lettered and provides a function, such as timing, control, or the sending of data.

Sampling
In the music business, digital sampling is the taking of sounds from an established musical sequence to reproduce them at any pitch, in any combination, with any tempo on a standard electronic keyboard. In electrical engineering, sampling is the automatic measurement of an analog signal at periodic intervals. *Sampling*, *quantizing*, and *encoding* are used to convert the analog signal to digital form.

Scanning
The representation of an image electrically as a series of horizontal lines formed by moving a sensor across the image from left to right repeatedly while moving from the top to the bottom of the image.

Scratching
The rearranging of other people's chords and notes into new melodies.

Shipping
Electronic industry jargon for initial public distribution of a new product.

SMPTE
Society of Motion Picture and Television Engineers. The SMPTE time code is a standard for a signal recorded on video tape to uniquely identify each frame for video editing.

SPA
Software Publishers Association.

T1 Carrier
The standard means for transmitting *pulse code modulated* (PCM) voice data. One frame, combining data from 24 sources, contains 193 bits (1 bit for establishing and maintaining synchronization plus, for each source, a 7-bit sample and an eighth bit for signaling and supervisory functions).

Timbuktu
Screen-sharing and file-transfer software by Farallon Computing for the Macintosh, allowing a *host user* to share the computer over a network with one or more *guest users*.

Toolbook
An applications construction set for developers and sophisticated users of IBM-compatible PCs that runs under Windows 3.0. Toolbook is a product of Asymetrix, a company founded by Paul Allen, co-founder and second largest shareholder of Microsoft Corporation, and co-creator of Microsoft's Basic program.

VAR
Value-Added Reseller.

Video Disc
A thin circular platter on which motion video, audio, and data signals are encoded and recorded optically in the form of *pits* and *lands* along spiral tracks. Recording is accomplished by focusing a high-power laser on the photo-resist layer of a master disc. Playback is accomplished by reflecting the light of a low-power laser from the disc onto a photo diode. Also see, *LV*, *CAV*, and *CLV*.

Videotex
A class of systems designed to provide information services to the home, originally conceived of as a merging of computers, communications, and television. As the home orientation met with rough waters, the scope of videotex was broadened to include on-line services for business as well, including the well-known News Retrieval service of Dow Jones. The primary display and control device for these services has shifted from the specially-equipped and remote-controlled television set to the personal computer, as in the *Prodigy* system. There have been many ambitious systems for videotex. Most, like *Gateway, Viewtron*, and *QUBE* failed.

Viewtron
A videotex system introduced by Knight-Ridder in Miami in 1983. The computer service, offering home banking and shopping, electronic mail, and extensive news reporting, did not attract and hold enough subscribers to stay in business.

Virtual Reality
Sights and sounds produced by supercomputers that do not exist as they are perceived by the observer.

Wideband
See *Broadband*.

Windows
Generally, boxed information displays that can be made to appear or disappear on the computer screen at will. In a more specific context, a *graphical user interface (GUI)* produced by Microsoft Corporation that runs under MS-DOS, Microsoft's operating system for IBM-compatible PCs. The software environment that Microsoft Windows provides is intended to mirror the features and success of Apple's Macintosh computer. Windows 3.0 is the latest version. It provides a platform for software such as *Toolbook* and for multimedia applications.

Xerox PARC (Palo Alto Research Center)
A highly talented computer group set up by the Xerox Corporation in Palo Alto, California in the early 1970s to do research on the office of the future. Researchers at PARC pioneered many of the innovations later implemented in the Macintosh and other personal computers by companies other than Xerox. Stewart Brand quotes David Thornburg: "One of the worst things that Xerox ever did was to describe something as the office of the future, because if something is the office of the future, you never finish it. There's never anything to ship, because once it works, it's the office of today." [Brand, p. 155]

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UCLA Roundtable in Multimedia
First Conference on Technologies for the 21st Century
March 26-27, 1990

1. Martin Greenberger
2. James W. McCallum
3. David Nimmer
4. Tim Bajarin
5. Bob Brannon
6. Charles M. Firestone
7. William E. Ahearn
8. Edward J. Belove
9. Ben Casados
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11. Ching-chih Chen
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14. Robert W. Lucky
15. Jack Sculley
16. Robert Abel
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33. Bernard J. Luskin
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35. Geoffrey Tulley
36. Miles Gilburne
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38. Richard Lanham
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40. Reese Jones
41. Robert Winter
42. Robert Stein
43. Carl F. Pompei
44. Michael J. Quinlan
45. Takashi Sugiyama
46. Sanford K. Fisher
47. Gordon V. Shirley
48. Nicholas Negroponte
49. Stewart Brand

Those Who Spoke:

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***Boldface** indicates the person referred to is speaking or making a comment. A small **n** after a page number indicates reference in a footnote.*

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